

Mr. Jackson
South Agriculture

The PROGRESSIVE FISH-CULTURIST

AUGUST, 1941

NO. 54



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
WASHINGTON

PROGRESSIVE FISH-CULTURIST

ISSUED BY

UNITED STATES DEPARTMENT OF THE INTERIOR ----- HAROLD L. ICKES, SECRETARY
FISH AND WILDLIFE SERVICE ----- IRA N. GABRIELSON, DIRECTOR

A SERIAL memorandum published occasionally for the advancement of fish-culture and fishery management in fresh waters.

TABLE OF CONTENTS

	Page
THE LIFE HISTORY and Control of an Eye Fluke, by M. S. Ferguson and Robert A. Hayford.....	1
ORGANIZATION OF the Fish and Wildlife Service, by W. R. Dillon.....	14
IS WILD TROUT Fishing Doomed?, by Lithgow Osborne.....	24
MARKING TROUT Under Anesthesia, by Richard F. Foster.....	30
EGG PRODUCTION of Walleyed Pike and Sauger, by Charles G. Smith.....	32
NOTES AND NEWS:	
Are Under-sized Trout Killed by Hooking?.....	35
A School for Fish-culturists.....	36
Creel Data on Clackamas River.....	37
Experimenters Favor Conditioning Trout Before Planting.....	38
COMMENTS FROM OUR READERS:	
Comment on Carl's Article.....	39
What Kind of Fish Are We Planting?	39
Non-migratory and Autumn-spawning Rainbow Trout.....	41
Peeling Paint is Cause of Fingerling Loss.....	43
ABSTRACTS: Sixth North American Wildlife Conference	
An Appraisal of Stream Improvement Programs of the National Forests of the Northeastern States, by Theodore C. Fearnow.....	44
Density Currents in Impounded Waters, by A. H. Wiebe.....	45
The Use of Fertilizer for Controlling the Pond Weed <u>Najas</u> <u>Guadalupensis</u> , by E. V. Smith and H. S. Swingle.....	45
Two Processes for the Reduction in Abundance or Elimination of Fish Species from Certain Types of Water Areas, by Thomas H. Langlois.....	46
A Preliminary Report on the Census of Commercial Fishing in Tennessee Valley Authority Impoundments, by Paul Bryant and Clarence M. Tarzwell.....	47
A Second Season on the Lower T. V. A. Reservoirs, by Clarence M. Tarzwell.....	47
REVIEWS:	
Gabrielson, Ira N. Wildlife Conservation.....	49

EDITORIAL STAFF

Editor

Elmer Higgins, Chief, Division of Fishery Biology, Fish and Wildlife Service

Assistant Editor

R. L. Carson, Division of Fishery Biology, Fish and Wildlife Service

Associate Editors

Dr. H. S. Davis, In Charge, Aquicultural Investigations Fish and Wildlife Service

Dr. Lauren R. Donaldson, School of Fisheries, University of Washington

Dr. A. S. Hazzard, Institute for Fisheries Research, Michigan Conservation Department

M. C. James, Assistant Chief, Division of Fish Culture, Fish and Wildlife Service

Dr. A. H. Wiebe, Biological Readjustment Unit, Tennessee Valley Authority

Dr. Louis E. Wolf, New York Department of Conservation

(Continued on inside back cover)

The PROGRESSIVE FISH-CULTURIST

News and Views from many Sources on Practical Hatchery Problems

Memorandum I-131

Washington, D. C.

August 1941

No. 54

THE LIFE HISTORY AND CONTROL OF AN EYE FLUKE

AN ACCOUNT OF A SERIOUS HATCHERY DISEASE CAUSED BY A PARASITIC WORM

By M. S. Ferguson

Department of Animal and Plant Pathology

Rockefeller Institute for Medical Research, Princeton, New Jersey

and

Robert A. Hayford

State Fish Hatchery, Hackettstown, New Jersey

PALMER IN 1939 (14) published an account of the eye disease which, during 1938, caused serious loss among several species of fish at the State Fish Hatchery, Hackettstown, New Jersey. Thousands of fish, particularly rainbow trout, became blind or had impaired vision due to the presence in the lenses of larval flukes (trematodes), and had to be destroyed.

The writers are now able to report further on the eye-fluke problem. The life cycle of the parasite has been demonstrated experimentally, and, since the hosts are known, it has been possible to apply effective methods for controlling eye-fluke disease at Hackettstown.

LIFE CYCLE OF EYE FLUKE

General.--The parasite in the eyes of the Hackettstown fish represents the last larval stage, or metacercaria, of a fluke (trematode) belonging to the group known as strigeids. The members of this group, in common with a great many other trematodes, have complicated life histories. Usually 3 hosts are required to complete the strigeid cycle, and in some cases even 4 are necessary. Most of the trematodes with complicated life histories, including the one considered here, pass through their early development in snails. With the eye fluke the next host is the fish. For completion of its development, i.e., attainment of sexual maturity, the eye stage must be eaten by a certain bird in whose intestine it becomes an adult worm which produces eggs.

A study of the Hackettstown eye fluke shows that it is the metacercaria of a strigeid worm belonging to the genus Diplostomum. As Palmer (14) pointed out, it is very difficult to identify strigeids when but one stage in the life cycle is studied. For accurate differentiation of species the various stages in the cycle must be considered. Therefore, it was desirable to obtain the adult stage of the Hackettstown worm. In the fall of 1938, heavily infested lenses from several species of the hatchery fish were fed to young, previously unfed, baby chicks with the hope that the metacercariae might survive and develop in the intestine into adult

worms. A week after the chicks were fed eye flukes they were killed, and several adult strigeids found in the intestine of each bird. When studied it was apparent that these parasites were similar to worms already described from three species of North American gulls. However, not one but two previously described species appeared to be represented. These were Diplostomum flexicaudum (17) and D. indistinctum (8, 9). Even yet, it is not clear whether or not two strigeids are present in the Hackettstown material, but there is already evidence to support the view that the worms known as D. flexicaudum and D. indistinctum are forms of one and the same species. Due to the marked similarity between D. indistinctum (8) and the adult stage of the strigeid D. spathaceum (adult of an eye fluke causing serious disease in European fish) it may even be shown that the same parasite is present in North America and Europe.

The life cycle of Diplostomum flexicaudum was worked out by Van Haitsma (17) in 1927 in experiments where larval flukes from the eyes of common suckers in a Michigan lake were fed to young herring gulls. Information obtained on the life cycle of the Hackettstown eye fluke corresponds very closely to details given in the case of D. flexicaudum. The course of development of the Hackettstown eye worms, as demonstrated experimentally, will be compared with what is known concerning the two above-mentioned North American strigeids, even though no definite statement can now be made as to the specific identity of the parasites being dealt with, other than that they belong to the genus Diplostomum. What is now known concerning these eye flukes is sufficient to enable hatchery men to recognize them whenever their fish become infested, and even to prevent this eye disease from ever breaking out in a hatchery. The life cycle is represented graphically in Figure 4, and details are given below.

Adult stage in the gull.--With the evidence indicating that the eye fluke became an adult worm in the intestine of gulls, a young uninfested laughing gull was fed, in August 1940, the eyes of several hatchery rainbow trout which were known to contain in their lenses a small number of metacercariae. Within a week characteristic strigeid eggs (Fig. 4, Nos. 2-4) were appearing in the feces, thus proving that the Hackettstown eye fluke would develop in gulls, or at least in the laughing gull. Several weeks later more infested eyes were fed to this gull just a few days before it died from an unknown cause. In the intestine were found a small number of adult trematodes identical in appearance with some of the worms recovered from chicks almost two years previously and very similar to the adult of D. flexicaudum from herring gulls as figured by Van Haitsma (17). They also closely resembled specimens obtained by Palmer from a herring gull shot at Hackettstown in the fall of 1938 and other strigeids from the intestine of two more herring gulls killed at the hatchery in December 1940. The general appearance of these worms is shown in Fig. 4, No. 1. As with many strigeids there is a broad leaf-like part to the body followed by a long cylindrical portion which contains the reproductive organs. The worms are small, vary from 2 to 3 millimeters in length, and apparently produce only a few dozen eggs.

Development in the egg.--Eggs pass out with the feces and if dropped in water develop, under favorable conditions, in about 2 or 3 weeks into the first trematode larval stage, the miracidium (Fig. 4, Nos. 5, 6). The miracidia of the Hackettstown worms have not been studied but it is justifiable to assume that they resemble the miracidia of D. flexicaudum as figured by Van Haitsma. These are very small swimming animals, less than 2/10 of a millimeter long. They resemble some protozoa but are multicellular, and are provided with many cilia for moving through the water. The internal organization is complex. The miracidia live only a few hours after escaping through a small opening at one end of the egg. If, during this period, they locate the proper species of snail, they penetrate its tissues and develop into the next stage in the cycle.

Stages in the snail host.--Van Haitisma showed that the miracidia of D. flexicaudum penetrated snails of the genus Lymnaea and that further development took place in the liver of these snails. Accordingly, laboratory-reared Lymnaea snails, descended from a stock which had originally been collected at the hatchery, were placed in aquaria with eggs from the feces of the laughing gull. In about 8 weeks representatives of the last free-living stage of the cycle, the cercariae, were observed to be emerging from the snails. These snails were identified as Lymnaea palustris (Fig. 1, h and Fig. 4, No. 7). It has been shown (5, 17) that the cercariae of D. flexicaudum develop in the following snails: L. emarginata angulata, L. stagnalis appressa, L. stagnalis perampla, and L. humilis modicella. The last species is also found at Hackettstown (Fig. 1, f). To help differentiate Lymnaea snails from some other mollusks the reader is referred to Fig. 1. This photograph includes the forms commonly found at the hatchery.

When the miracidium penetrates the snail it becomes a mother sporocyst which in turn gives rise in the liver to a large number of daughter sporocysts (Fig. 4, No. 8). In these structures cercariae are produced and when fully grown the latter escape from the sporocysts through a pore. They first begin to emerge into the water from the tissues of a snail about 6 weeks after the miracidium has penetrated. Thousands of cercariae may be released in a day, and this can continue for several weeks.

The cercaria.--Fig. 4, Nos. 9 and 10, are photographs of cercariae of the Hackettstown fluke in their characteristic resting position in the water after emergence from the snail. They are about half a millimeter long and consist of a body portion of complex structure and a forked tail. These cercariae resemble closely the cercariae of D. flexicaudum (5). The hatchery cercariae hang in the water with the fore end of the tail flexed at a sharp angle. They are only slightly heavier than water and due to the flexure and the forks of the tail tend to sink very slowly. About the only movement they exhibit when undisturbed is an occasional energetic upward motion which places them at a higher level in the water, from which they slowly settle after assuming the resting position. These cercariae live a day or less after emerging from the snail and perish if they do not come in contact with a suitable fish host.

The fish-eye stage, or metacercaria.--Blackhead minnows, bluegill sunfish, common sunfish, small-mouth black bass, and Oswego bass, were placed in small dishes with large numbers of cercariae that had emerged from infested Lymnaea snails. Examination of the eyes on the following day always revealed a number of small worms in the lenses, similar in appearance to the body of the cercariae. When a cercaria penetrates a fish it loses the tail, and the body portion migrates toward the eye where further development occurs in the lens. Large numbers of worms are able to attach themselves to a fish within a few minutes if it swims near a snail that is shedding cercariae.

In the lens the body part of the cercariae increases in size and finally becomes, in about 6 weeks, a metacercaria or eye fluke (Fig. 3 and Fig. 4, No. 11). These parasites are flat, oval in shape, less than half a millimeter long, and correspond roughly to the fore part of the adult worm previously described (Fig. 4, No. 1). They apparently live and remain healthy in the lenses of fish for months after having completed their development. When the infested eyes are eaten by a gull (Fig. 4, No. 13), the cycle is completed and adult egg-producing worms are again formed.

The eye flukes developing in experimentally infested fish were similar to those obtained from the eyes of infested hatchery fish in 1938 and 1940. They resemble closely the metacercariae of D. flexicaudum (11).

For completion of the entire life cycle under favorable conditions approximately 4 months are required. Low temperatures likely extend this time consider-

ably. The eye disease first became noticeable at Hackettstown during August 1938. It is probable that snails were infested with miracidia hatching in April as the water began to get warmer. Gulls appear in varying numbers at the hatchery during the late fall, winter, and early spring months. Few are present during the summer. Snails, therefore, likely became infested at one time of year, i.e., in the spring.

FISH HOSTS OF THE EYE FLUKE

At Hackettstown rainbow, brown and brook trout, common suckers, bluegill sunfish, small-mouth black bass, and forage minnows have been found to be infested with eye flukes. As reported by Palmer, rainbow trout were more heavily infested than brown or brook trout. The eyes of many of the suckers and minnows contained large numbers of flukes, while those of the bluegill sunfish and small-mouth black bass usually harbored only a few worms. Consequently, blindness was found mostly among rainbow trout, common suckers, and forage minnows.

In experiments, small-mouth black bass, Oswego bass, common sunfish, and blackhead minnows exposed to cercariae from the Lymnaea snails have become infested with eye flukes. The metacercaria of D. flexicaudum was described (11) from the eyes of common suckers. Over 94 percent of the common suckers in Douglas Lake, Michigan, were found to be infested with eye flukes (13). Yellow perch (Perca flavescens), bull-heads (Ameiurus nebulosus), and pickerel (Esox lucius) became infested when exposed to the cercariae of D. flexicaudum (17). Eye flukes have also been reported from several other species of fish in North America.

In Europe over 40 species of fish have been recorded as hosts for the eye fluke which is the metacercaria of D. spathaceum (8). The disease caused by these worms has long been encountered in hatcheries as well as in natural waters (15,16). Apparently Palmer's paper is the first published report on eye-fluke disease in a North American hatchery. When details of the life cycle of these worms are recalled, it will seem very improbable that other hatcheries have not at some time experienced similar trouble. The disease may have been less severe and was not recognized, or if it was recognized, may not have been reported.

PATHOLOGICAL EFFECTS ON FISH

When some blackhead minnows recently were exposed to several thousand eye fluke cercariae all the fish were dead within 12 hours. Van Haitisma reports a similar rapid death when common suckers and hog-nosed suckers were infested with large numbers of the cercariae of D. flexicaudum. Such observations are also reported for fish exposed to the cercariae of D. spathaceum (18).

If death does not result, other striking effects are observed when many eye fluke cercariae invade a fish host within a few hours. Small red patches often occur on the body and fins where the worms have penetrated and ruptured blood vessels. The whole under part of the head may appear as a large red patch. A "popeye" condition (Fig. 2) often results and sometimes develops within 5 hours after the minnow is exposed to several hundred cercariae. This bulging, usually accompanied by redness of the entire eyeball, will persist in the blackhead minnow for several days and only gradually disappears. In severe cases the fish are probably blind from the outset and sight is not regained. The "popping" is due to the accumulation of fluids in the eyeball. The eye lenses of these fish may soon appear white through the cornea and in some the lens has been found to have completely disappeared. In such eyes apparently no flukes survive. At the hatchery some trout, which probably had been very heavily infested, were observed to have eyes which had burst open and lost their contents.

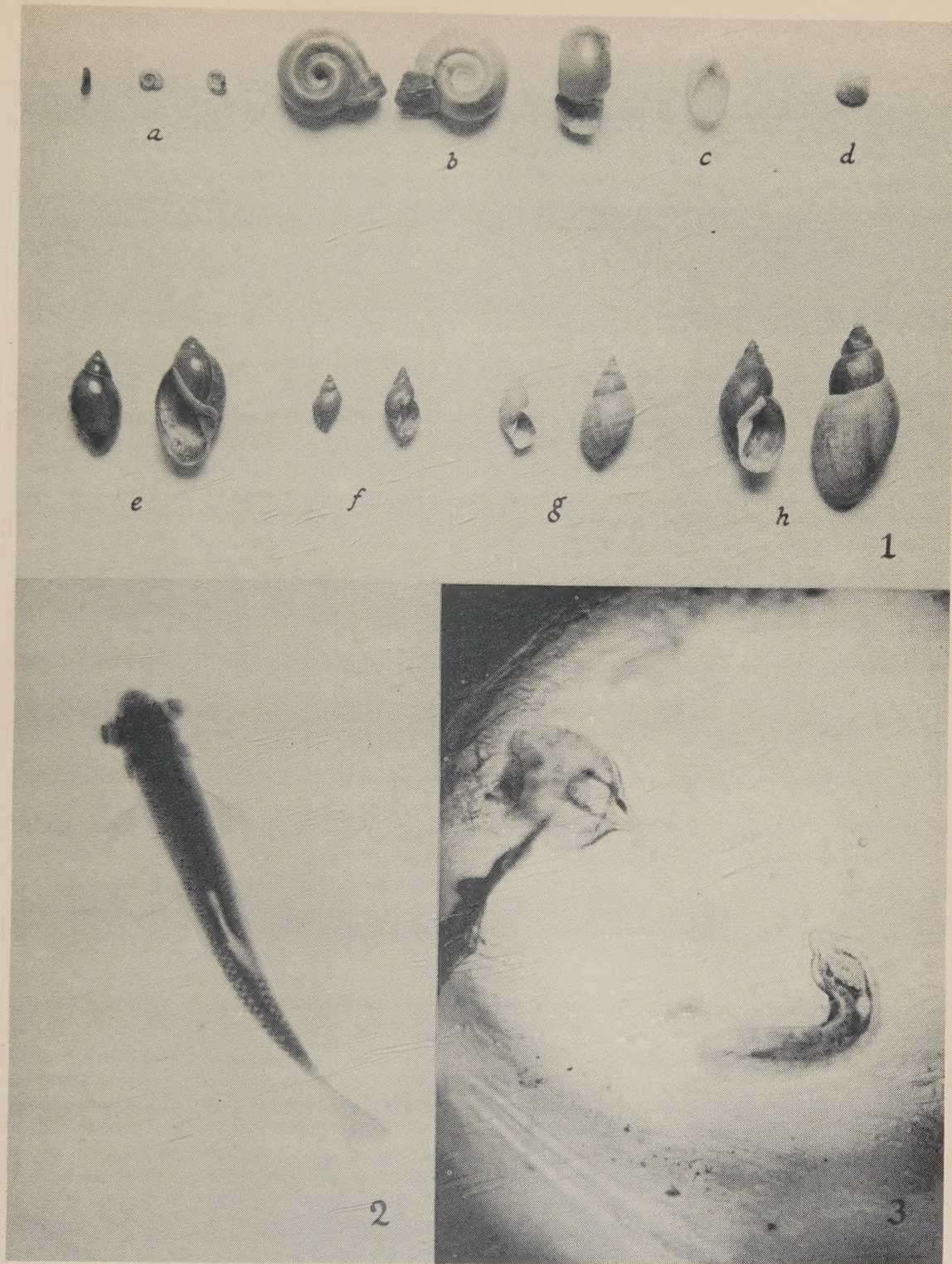
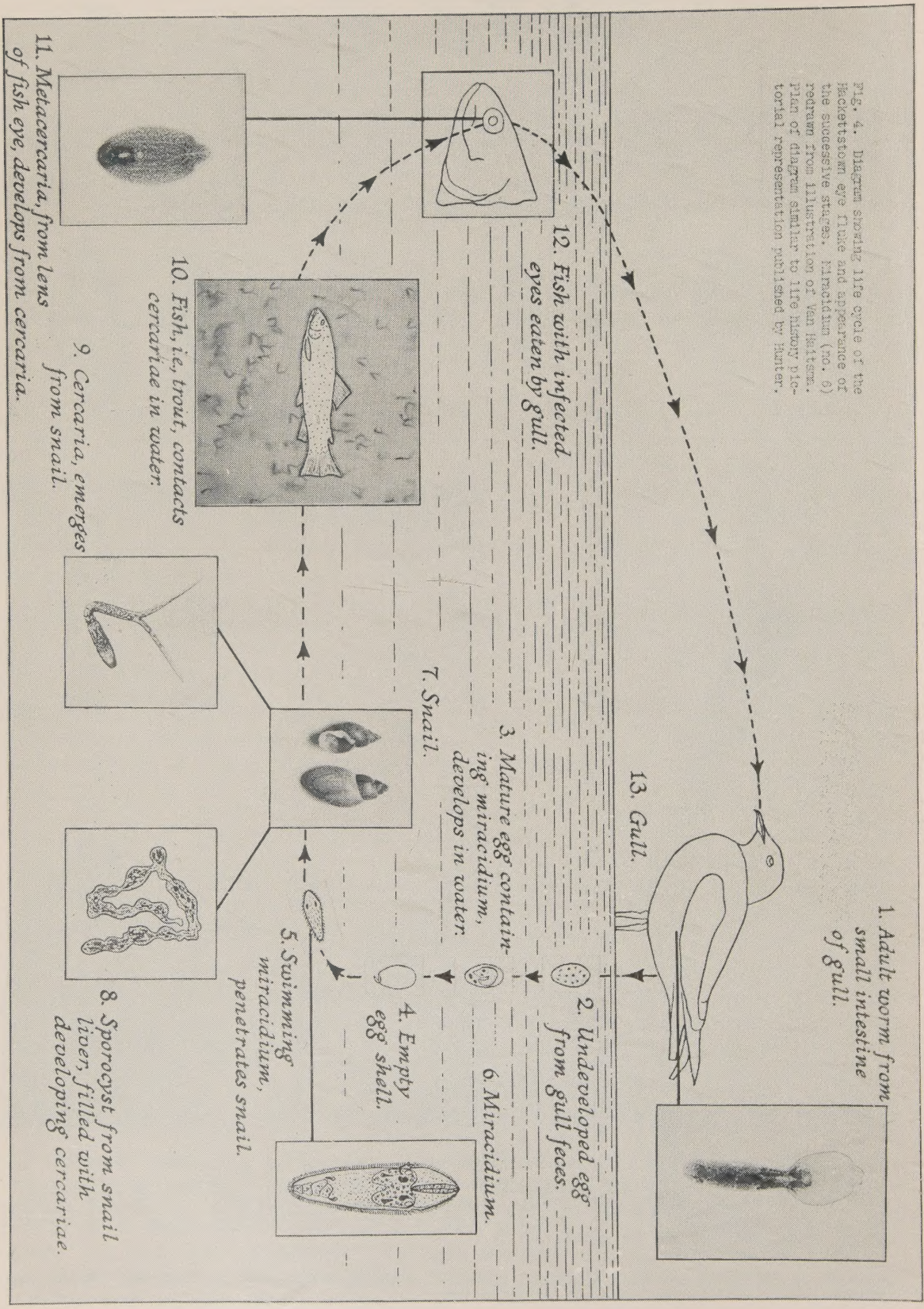


Fig. 1. The water snails and other mollusks commonly found at the Hackettstown Hatchery. a - Gyraulus parvus, b - Helisoma campanulatum, c - Succinea retusa, d - Musculium partumeium (a bivalve mollusk, e - Physa heterostropha, f - Lymnaea humilis modicella, g - Lymnaea ohrussa, h - Lymnaea palustris. All the above are found in water except Succinea retusa, which lives on grass, etc., just out of the water.

Fig. 2. A blackhead minnow (Pimephales promelas) showing severe case of "popeye", which developed about a day after exposure to cercariae.

Fig. 3. Portion of the lens of an experimentally infected bluegill sunfish showing two eye flukes. (Photographs by J. A. Carlile.)

FIG. 4. Diagram showing life cycle of the blacketstone eye fluke and appearance of the successive stages. Miracidium (no. 6) redrawn from illustration of Van Haeften. Plan of diagram similar to life history pictorial representation published by Hunter.



Where the infestation is light, or is acquired gradually, no such severe reaction occurs. The eye, depending upon the size of the fish, is able to accommodate a few dozen worms in the lens without later becoming cloudy. Under such circumstances bulging of the whole organ does not necessarily occur. However, as the number of worms increases and more of the lens material is destroyed, vision is probably seriously impaired. Opaque areas in the lens are seen under the microscope wherever a metacercaria is situated. When several dozen or one hundred or more worms are present the lens appears white through the cornea in the living fish, and, if both eyes are thus affected, the animal is probably totally blind. Palmer recovered as many as 170 eye flukes from one trout lens.

Blindness, therefore, may come quickly or gradually. At Hackettstown apparently the trout, suckers and minnows became blind gradually and consequently the sudden deaths were not encountered.

None of the small-mouth black bass, Oswego bass, or bluegills exposed to eye fluke cercariae in the laboratory appeared to have become blind. Further experimental work must be done with these fish to determine whether or not they are less susceptible to heavy eye infestations.

The blind fish at the hatchery, as they were unable to feed, gradually became emaciated. They were very sluggish in movement and the whole body was often dark in color. The whiteness of the eye was an immediate indication of trouble in that organ. However, the eyes of several fish had to be examined under the microscope before it could be determined whether or not the trouble was due to eye flukes. Davis (6) mentions eye "popping" and death in trout due to gases in the water, the accumulation of serous fluid around the eyeballs, perhaps bacteria, and larval trematodes that are not strigeids.

CONTROL OF EYE FLUKES

General. - The control of eye-fluke disease is difficult due to the several hosts involved in the life cycle and their particular characteristics. As yet there is no known method of destroying the parasites once they have invaded the fish's eye. Fortunately, worms cannot be naturally transferred from one fish to another. Therefore, if at least one link in the life-history chain can be broken, and kept permanently so, new infestations are eliminated. In a hatchery this can be accomplished much more readily than in natural waters.

Gulls may pick up eye flukes by eating infested fish from one body of water and can distribute their eggs far and wide into other waters. If the proper snail host is present, and miracidia hatching from the eggs are fortunate in finding it, cercariae will eventually emerge. As stated previously, there is a tremendous multiplication of the parasites in the snail, and several thousand cercariae may be released daily over several weeks by a single infested snail. Many of these cercariae are contacted by fish swimming in the vicinity of infested snails, or the free-living parasites may be carried in moving waters to other parts of a pond, lake, or into streams. Conditions such as are found in a hatchery provide ample opportunity for the maximum exposure of the concentrated fish population to infestation. Where ponds are connected and water flows continuously from one body of water into another, cercariae, due to their inability to move against a current, can be carried into ponds containing no infested snails. It is likely, however, that fish become most heavily infested while near the snails, i.e., near the shore of a pond. At Hackettstown in 1938 more blind fish appeared in those ponds containing large numbers of snails which had been frequented by gulls during the winter of 1937-1938.

Conditions at hatcheries are also favorable for the multiplication and growth of snails. In a recent visit to hatcheries in three different states one of the

writers noted that at every one snails of the genus Lymnaea were plentiful. Thus all these hatcheries probably have potentialities for trouble from eye-fluke disease, if numbers of infested gulls ever appear.

Fish which appear infested, i.e., having opaque eyes, may be destroyed in a hatchery, but if gulls are permitted to be around the ponds they will probably be kept well infested with adult worms by eating fish which harbor only a few eye flukes. Then, too, the gulls can bring the infestation into a hatchery or new territory from natural feeding waters some distance away. Gulls can be destroyed¹ or kept away from hatcheries by having someone on continual guard with a shotgun. However, a few dozen eggs dropped into the water with feces of an occasional unobserved gull may be sufficient to cause trouble.

As yet, the best method of attack for controlling eye flukes, as well as many other trematode diseases, is to destroy the snail hosts through the use of chemicals so that no cercariae are released into the water. This method is coming into use for killing the snail host of the blood fluke cercariae that cause "swimmer's itch" in bathers at the beaches of some of our northern lakes (2). If a pond is drained and left dry for a time some snails will die, but usually large numbers of certain species survive for a considerable period, either because they descend into the mud or have special means of protecting themselves from excessive drying. Snail control has been carried on effectively at Hackettstown and, since 1938, practically no loss among trout or other fish has resulted from eye-fluke disease.

Control of snails by use of chemicals. - During the past two years several papers on the chemical sterilization of hatchery waters have appeared in this publication (4, 7, 10, 19). Copper sulphate, potassium permanganate, calcium hypochlorite, chlorine gas, and derris root powder have been used to advantage. Some of the chemicals are more suitable than others, depending upon the infection being combatted, the character of the water and type of pond to be treated.

At Hackettstown all sterilization for killing snails in trout ponds has been done with the use of calcium hypochlorite (trade name "HTH"), chlorine gas, and copper sulphate. The methods used are as follows and in most respects are somewhat similar to those mentioned above (4, 7, 10, 19). The chemical employed depends upon the size of the pond, the type of bottom, and the kind of inlet leading into it - factors which determine the cost as well as the efficiency of the treatment.

If possible all ponds are drained, the larger plants removed, and the bottom and sides of each pond thoroughly washed out with a stream of water from a fire hose attached to a motor-driven pump. This dislodges many snails and removes much of the dead organic matter into which these animals could crawl. The vegetation and any crevices around the usual water level are also given a thorough washing.

Where the inlet pipe is 12 to 15 feet long, 10 to 12 inches in diameter, and the pond can be filled with water in one day, or the treatment continued until the pond is full, chlorine gas from cylinders is used. A 16-foot garden hose is attached to the cylinder and a 2-foot finely perforated galvanized pipe fastened to the other end. The free end of the garden hose is then placed in the intake end of the inlet pipe. This pipe is kept full of water. The chlorine is released slowly and allowed to bubble into the water as the pond fills. The procedure is continued until, when the pond is full, about 10 parts per million of free chlorine are dissolved in the water (as determined by a Hellige chlorine comparator). The treated pond is kept full overnight and drained the following day.

If the pond has a good gravel bottom and is fed by clear water (factors which help to limit the expense of treatment with chlorine), granular calcium hypochlorite or "HTH" (providing not less than 70 percent available chlorine) is employed.

¹Gulls are protected by Federal law. It is possible under certain circumstances to obtain a Federal permit to shoot them, but it is illegal to do so without such permit. - Editor

As a previously drained and washed pond fills, the "HTH" is sprinkled into the water at the intake end. The incoming water becomes chlorinated as it passes over the chemical. The chlorine is liberated slowly when the "HTH" dissolves and is taken up by the water over a much greater area than when gas in cylinders is used. The amount of "HTH" to be added to each pond in order to have 10 parts per million of free chlorine is determined by testing the water from time to time with the chlorine comparttor. These ponds are also allowed to remain full overnight before being drained the next day.

Davis (7) has given an explanation of the way chlorine gradually disappears from the treated pond as more and more of the gas is combined with the water to form hypochlorous acid and some hydrochloric acid. In the direct sunlight the hypochlorous acid breaks down into hydrochloric acid and oxygen. Then more chlorine unites with the water, and these processes continue until, after a time, the gas has all disappeared. Less chlorine disappears from the water during the night, and a considerable amount may remain which could have serious effects on fish in the brook into which the hatchery ponds are drained the day following treatment. Aeration helps to remove rapidly a great deal of chlorine. Many hatcheries now use aerators for getting rid of gases naturally occurring in waters, and these devices should be satisfactory for removing excess chlorine. If the brook into which chlorinated water flows is moving swiftly over rocks, aeration will occur and the remaining chlorine be largely lost. Mixing the treated water with a large amount of untreated water as it leaves the pond also serves to reduce the amount of chemical per unit volume. In all cases, where there is a possibility of danger to fish and other animals, a constant check should be made as the treated water leaves the hatchery so that too much free chlorine is not present at any one time.

Copper sulphate is used at Hackettstown for treating large ponds that cannot be filled in one day, and where a thorough cleaning by washing is very difficult or impossible. Ponds with a high chlorine demand (such as those having much organic matter suspended in the water) are also treated with copper sulphate since great expense would be involved in the use of the previously mentioned chemicals.

A pond to be sterilized with copper sulphate may either be full or empty when operations are begun. Small amounts of the chemical in its coarse form are placed in a burlap bag which is suspended in the inlet pipe as the pond is being filled. If the pond is full, powdered copper sulphate is placed in a cheesecloth bag fastened to one end of a long pole. This bag is dipped in and out of the water all around the pond. At Hackettstown the water contains much calcium carbonate and consequently about 40 percent of the copper sulphate precipitates (determined by chemical analysis). Because of this precipitation the pond is treated until the concentration of dissolved copper sulphate in the water reaches 20 parts per million. The requirement is determined by estimating as accurately as possible the volume of water in a pond and then calculating the amount of copper sulphate needed to give the desired concentration after the precipitation has been allowed for. A treated pond is left standing overnight and is drained the next day. The bottom and sides are washed out with the fire hose in order to remove as much as possible of the copper precipitate that has settled to the bottom, which, if allowed to remain, might destroy fish introduced into the pond after treatment.

In using the above methods for killing snails a great deal of caution must be used. The operator should have a gas mask for protection against chlorine gas in case of emergency. Ponds to be treated must be thoroughly checked for leaks as escaping chemicals may cause great harm to fish in adjacent ponds or in a brook.

It is very difficult to kill all the snails in a trout pond through one treatment. Some creep out of the treated water and others may go down into the mud where chemicals do not destroy them. Therefore it appears that it may be necessary to sterilize ponds twice a year, such as early in the spring and in the fall

before winter sets in. Brackett (3) has found that in species of Lymnaea, the adult snails naturally die by the end of the summer while snails hatching during the year live over to become sexually mature adults the following year. These in turn die by the next fall after reproducing. With the natural death in the fall of Lymnaea snails that have survived the spring treatment of the ponds in a hatchery, and the killing of many of the young snails that have developed during the summer in the fall treatment, the population is gradually cut down. After a few years of sterilization of hatchery waters the number of snails can likely be reduced to a minimum. Even after this, a yearly check of all ponds should be made to determine if snails have come into the hatchery from the outside.

The sterilization of ponds by chemicals, as just described, and the general cleaning carried out during the operations serve not only to kill off snails but should also be of value in controlling some other harmful organisms, including bacteria (7).

The mass destruction of snails should be restricted to fish hatcheries. Baker (1) and Wesenberg-Lund (18) stress the important role which snails have in the interplay between organisms in a lake or pond, and emphasize that if they are removed the delicate balance in the environment may be severely disrupted. Snails help to determine the amount of lime deposits in a lake, the calcium content of the water, and destroy plant material both living and dead. If chemicals are widely used in natural waters, not only are snails destroyed, but also numerous other animals and plants, all of which have to do with the character of the water and many of which serve as food for fish. Numbers of fish will likely be destroyed also. The environment can thus be rendered unfavorable for fish, the animals which one is trying to protect.

In hatcheries, where there is a continual change of water in ponds and food is supplied artificially as in trout culture, the situation is different. When fish, such as bass and bluegills, are reared in large hatchery ponds on natural food, periodic chemical sterilization for the control of snails would seriously interfere with the food chain upon which these fish depend. Further studies must be made to determine if bass and bluegills are susceptible to heavy infestations with eye flukes. If so, special procedures will have to be worked out for protecting these fish from the eye disease.

SUMMARY

An eye disease, previously reported by Palmer, which caused blindness in large numbers of fish, especially rainbow trout, at the Hackettstown, New Jersey, State Fish Hatchery is dealt with in various aspects.

The disease was due to the presence of many individuals of the last larval stage (metacercaria) of a strigeid fluke or trematode in the eye lenses. The worms belong to the genus Diplostomum.

The identity of the Hackettstown eye fluke has not yet been fully determined. In appearance and life history details, the material resembles the North American strigeids, Diplostomum flexicaudum and D. indistinctum. This trematode also closely resembles in its various stages the European strigeid D. spathaceum, a fluke also causing blindness in fish.

The life cycle of these worms has been demonstrated experimentally. The hosts are snails of the genus Lymnaea, various species of fish, and gulls. The gull becomes infested when fish harboring eye flukes are eaten. Adult worms develop in its intestine in about one week. Eggs are produced and get into water with gull feces. In about 3 weeks the eggs hatch into the first swimming larval stage, or miracidia, which infest species of Lymnaea snails. Approximately 6 weeks later

numbers of the last swimming larval stage, the cercariae, begin emerging from the snail tissues. These worms, if suitable fish come near them, penetrate their tissues and migrate to the eye where they develop in about 6 weeks into eye flukes or metacercariae. The life cycle under favorable conditions requires roughly 4 months for completion.

At Hackettstown, rainbow, brown, and brook trout were affected. More of the rainbow trout became blind. Common suckers, bluegill sunfish, small-mouth black bass, and forage minnows also harbored eye flukes. Oswego bass, common sunfish, and blackhead minnows became infested when exposed in the laboratory to cercariae of the hatchery eye fluke.

Some blackhead minnows, exposed to a few hundred cercariae developed a "popeye" condition in about a day and were permanently blinded. In other experiments the minnows died within a few hours. At Hackettstown, the fish apparently became infested gradually and were blinded slowly as the eye lenses were destroyed. The eye of blind fish appears white through the cornea. In some cases the contents of the eyes were lost.

Blind fish cannot feed properly even in a hatchery, become emaciated and sluggish, and eventually die.

Eye-fluke disease in hatcheries can be controlled to some extent by attempting to keep gulls away. The best known method of control is to keep one link in the life-history chain permanently broken, such as by destroying snails in hatchery ponds.

Chemicals have been found to be very effective in snail control, and since 1938 practically no loss has resulted from eye fluke disease at Hackettstown. Chlorine gas, calcium hypochlorite, and copper sulphate have been used successfully for sterilizing trout ponds. Methods for the use of these chemicals are described. The sterilizing agent to be employed depends upon the size and type of bottom of a pond, the amount of organic matter suspended in the water, the type of inlet, and the relative cost of treatment.

Due to the important role of snails in the interplay between organisms in a lake or pond the promiscuous destruction of these animals is not to be advocated. In trout hatcheries, where pond conditions are more artificial and special food is supplied, the destruction of snails and other organisms is apparently not a serious factor. If bass and bluegills are shown to be susceptible to heavy eye-fluke infestation, special procedures for protecting them from the eye disease will have to be employed where these fish are reared on natural food that would be destroyed or greatly reduced in amount by the methods of pond sterilization mentioned here.

ACKNOWLEDGMENT

The writers acknowledge with appreciation assistance given by Charles O. Hayford, Superintendent of the Hackettstown Hatchery, for his great interest in this problem and many courtesies extended; by R. A. McLean, Academy of Natural Sciences of Philadelphia, in identifying the Hackettstown mollusks; by E. D. Palmer in loaning specimens of worms recovered from gulls; by E. W. Surber, Leetown, West Virginia, in supplying live blackhead minnows; and by C. B. Worth, Swarthmore College, in the collection of young laughing gulls in southern New Jersey.

LITERATURE CITED

- (1) BAKER, F. C.
1922. Fluke infections and the destruction of the intermediate host.
Jour. Parasitol., 8: 145-147

- (2) BRACKETT, S.
1939. Methods for controlling schistosome dermatitis. Jour. Amer. Med. Ass., 113: 117-121.
- (3) BRACKETT, S.
1940. Studies on schistosome dermatitis. VIII. Notes on the biology of the snail hosts of schistosome cercariae in Wisconsin and epidemiologic evidence for the life cycles of avian schistosomes. Am. Jour. Hyg., 32 (D): 85-104.
- (4) CONNELL, FRANK H.
1939. Sterilizing ponds. Prog. Fish-Cult., 44: 35-36
- (5) CORT, W. W. and S. T. BROOKS
1928. Studies on the holostome cercariae from Douglas Lake, Michigan. Trans. Amer. Microsc. Soc., 47: 179-221.
- (6) DAVIS, H. S.
1937. Care and diseases of trout. U. S. Bur. Fish., Inv. Rept. 35: 1-76.
- (7) DAVIS, H. S.
1938. The use of chlorine for disinfecting fish ponds. Progressive Fish-Cult., 42: 24-29.
- (8) DUBOIS, GEORGES.
1938. Monographie des Strigeida (Trematoda). Mémoires de la Société Neuchateloise des Sciences Naturelles. Université, Neuchatel, Suisse, VI: 1-535.
- (9) GUBERLET, JOHN E.
1922. Three new species of Holostomidae. Jour. Parasitol., 9: 6-14
- (10) HAGEN, WILLIAM, JR.
1940. Sterilizing hatchery water supplies. Prog. Fish-Cult. 48: 19-24.
- (11) HUGHES, R. C. and P. G. BERKOUT.
1929. Studies on the trematode family Strigeidae (Holostomidae) No. XV. Diplostomulum gigas sp. nov. Papers Mich. Acad. Sci., Arts, and Let., 10: 483-488.
- (12) HUNTER, G. W., III.
1937. Parasitism of fishes in the lower Hudson area. Suppl. 26th Ann. Rept. N. Y. State Conservation Dept. Biol. Surv., XI: 264-273.
- (13) La RUE, G. R., E. P. BUTLER, and P. G. BERKOUT.
1926. Studies on the trematode family strigeidae (Holostomidae) No. IV. The eyes of fishes an important habitat for larval Strigeidae. Trans. Amer. Microsc. Soc., 45: 282-288.
- (14) PALMER, EDDY D.
1939. Diplostomiasis, a hatchery disease of fresh-water fishes new to North America. Prog. Fish-Cult., 45: 41-47.
- (15) PLEHN, MARIANNE.
1924. Praktikum der Fischkrankheiten. In Demoll, R. u. Maier, H. N., herausg. Handbuch der Binnenfischerei Mitteleuropas. 1: 447-449. Stuttgart.
- (16) SZIDAT, L.
1927. Ueber ein Fischsterben im Kurischen Haiff und seine Ursachen. Z. Fischerei, Neudamm, u. Berlin, 25: 83-90.
- (17) VAN HAITSMAN, JOHN P.
1931. Studies on the trematode family Strigeidae (Holostomidae). No. XXIII: Diplostomum flexicaudum (Cort and Brooks) and stages in its life-history. Papers Mich. Acad. Sci., Arts, and Lett., 13: 483-516.

(18) WESENBERG-LUND, C.

1934. Contributions to the development of the Trematoda Digenea. Part II. The biology of the freshwater cercariae in Danish freshwaters. D. Kgl. Danske Vidensk. Selsk. Skrifter, Naturv. og Math. Afd., 9 Raekke, V, 3. (Mem. Acad. Roy. Sci. Lett. Danemark, Copenhagen. Sect. Sci., 9^{me} Serie, t. V, No. 3.)

(19) WOLF, LOUIS E.

1940. The value of disinfection in ulcer disease. Prog. Fish-Cult., 49: 35-36.

TO COOPERATE IN HANDLING HATCHERY OUTPUT IN STATE

Nebraska fishermen are expected to have better fishing opportunities as a result of a tentative cooperative agreement recently drawn up for handling fish produced at the Federal hatchery at Crawford, Montana.

The agreement entered into between the Fish and Wildlife Service and the Nebraska Game, Forestation and Parks Commission would provide that the output of the Service's Crawford station--both cold and warm water species--be distributed within the confines of the State of Nebraska, without cost to the Fish and Wildlife Service. This Service, however, would furnish an assistant during the distribution.

In addition, the Service would agree to give any surplus fish to the Game, Forestation and Parks Commission after all of the former agency's applications for all waters have been filled.

A final paragraph of the Nebraska proposal states that there will be an interchange of horsemeat, used as fish food, should there be a supply above the needs of the Fish and Wildlife Service at the Crawford station. This horsemeat applies to that given the Service from the U. S. Army Remount Station.

SALVAGING THE COLUMBIA RIVER SALMON

Operations for the salvaging of migrant salmon and steelhead trout below the impassable Grand Coulee Dam are being carried out successfully for the third consecutive summer, according to reports received from Joseph A. Craig, in charge of the Columbia River salmon-salvage operations for the Fish and Wildlife Service. During the period from April 1 to July 12, a total of 4,285 commercially important fish have been trapped, transported in tank trucks, and liberated either in natural spawning areas or in holding ponds at the Leavenworth hatchery. Broken down into species, this total consisted of 1,701 chinook salmon, 614 blueback salmon, and 1,970 steelhead trout. Out of the total number of fish hauled to July 12, Leavenworth hatchery had received 449 chinooks, 614 bluebacks, and 1,071 steelhead trout; while Nason Creek had received plants of 1,252 spring chinook salmon and 899 steelhead trout.

Plans reported by Mr. Craig for distributing the remainder of the run of salmon and steelhead trout are as follows: 25 percent of the summer-run chinook salmon will be hauled to the hatchery and the remaining 75 percent will be liberated on the Wenatchee River. None of the summer- and fall-run steelhead trout, other than those which inadvertently are hauled with chinooks or bluebacks, will be hauled to streams or lakes. Instead, all steelhead trout will be hauled to the hatchery. All but 1,500 blueback salmon (the number reserved for Leavenworth hatchery) will be liberated in Lakes Wenatche and Osoyoos.

ORGANIZATION OF THE FISH AND WILDLIFE SERVICE ¹

By W. R. Dillon
Chief, Division of Administration
Fish and Wildlife Service

UNDER AUTHORITY OF THE REORGANIZATION ACT approved April 3, 1939, the President's Reorganization Plan No. II directed the transfer of the Bureau of Biological Survey from the Department of Agriculture to the Department of the Interior effective July 1, 1939. Under the same order and as of the same effective date the Bureau of Fisheries was transferred from the Department of Commerce to Interior. One year later, under the President's Reorganization Plan No. III, the two bureaus were consolidated into what is now known as the Fish and Wildlife Service. It may be well to point out here that consolidation in the written word is a much simpler action than consolidation as a practical operation. Each bureau had its own organization structure. These had to be changed in many respects to intergrade similar functions and avoid duplication of effort. This major task started even before the order actually became effective and it is still in progress. It will be many months before all the numerous details are ironed out and we can feel that we are getting "in high gear" as a smooth-running organization.

There are two general types of organization. One is known as the vertical, which leans largely to centralized control; the other as the horizontal, in which control is decentralized to such degree as is determined by the head of the organization to be safe without loss of control. In either case the organization structure must be carefully planned to insure that closely related work falls into the same unit; also that it does not duplicate work being performed in another unit. Supervisory authority must be clearly defined. There must be no uncertainty with the man on a specific job as to his duties and from whom he is to receive instructions and obtain advice.

The Fish and Wildlife Service is neither a completely vertical nor a completely horizontal organization. Located in Washington are the Director, the Assistant Directors, and the Chiefs of Divisions. In the field are five Regional Directors with offices situated within definitely prescribed geographical boundaries--called regions. All project leaders engaged in strictly administrative and regulatory work confined to a given region report to the Regional Director of that region. These project leaders are responsible to the Regional Director, and to him only, for the efficient performance of their duties. The Regional Directors, in turn, are responsible to the Director of the Service. The latter depends upon his Division Chiefs to see that the regional directors are properly instructed and that they conduct efficiently the activities in the field of the respective divisions. Thus the Division Chiefs in the Fish and Wildlife Service act in the capacity of staff officers with authority to prescribe all except major policies and procedures with regard to their respective operations. From that point the Regional Directors take over and see that the work is properly executed. The lines of authority are clearly defined--with responsibility for general supervision of actual operations and effective accomplishment in the field where the work is being performed.

¹ An address delivered at the first of a series of special in-service training courses conducted at the Patuxent Research Refuge in February, 1941.

While administrative and regulatory functions are organized on a regional basis, research and investigative functions which as a rule have wide application are not included in the regional organization. Thus all personnel of the Divisions of Wildlife Research, Fishery Biology, and Fishery Industries report through their respective project leaders and Division Chiefs to the Director, as do also the employees of the Division of Alaska Fisheries.

THE IN-WASHINGTON SERVICE ORGANIZATION

As presently constituted the Washington, D. C., office of the Fish and Wildlife Service is composed of the Director and two Assistant Directors, as stated previously, the Chief Counsel and his staff, technical and other assistants to the Director, and 13 Divisions. Each of these divisions has certain broad functional duties to perform. Most of the divisions are organized into sections or units depending upon the scope or variety of action programs. In addition, the Division Chief has one or more assistants, plus clerical personnel, who aid him in reviewing the work of the sections and in handling directly major problems and miscellaneous matters not susceptible to assignment outside of his immediate office. Each section is headed by a section chief responsible to the Chief of Division. The flow of work may be between sections prior to review by the Division Chief. In such instances each section concerned is responsible for the performance of some part of a given task. In other cases the work may flow directly from a section chief to the Chief of Division. Flow of work between Divisions is much less frequent because of the broader diversity of functions.

DIVISION ORGANIZATIONAL LINES AND FUNCTIONS

As you will have noted, it is difficult to discuss organization without combining with it functions and work flow. These three are so closely related as to be almost inseparable. A discussion of division organization and work flow is essential to get a clear picture of the lines of authority.

The Division of Public Relations is responsible for the dissemination of information and the preparation of publications relating to the work of the Service. The divisional organization includes two sections in addition to the office of the Chief. The Editorial Section, as its name implies, edits and supervises the editing, with a few exceptions, of all manuscripts to be published by the Service or for use in outside publications. It handles layouts of illustrations, and revisions of proofs, maintains mailing lists, plans for initial distribution of publications, supervises the operations of the Service Library, and handles work of a similar nature. The Section of Current and Visual Information is responsible to the Chief of the Division for the dissemination of information to the public by means of press statements, radio broadcasts, magazine articles, addresses, motion pictures, slides and film strips, photographs, and correspondence. It maintains files of photographs and stocks of publications and fills requests for these as received from correspondents and others. The house organ entitled "The Service Survey", is prepared for issuance by this Section.

The Division of Wildlife Research plans and directs the wildlife research activities of the Service. The Division has six Sections and three independent units, all responsible to the Chief of the Division. The names of the sections are indicative of the work performed therein. They include the Section of Fur Resources, the Section of Food Habits, the Section of Distribution and Migration or Birds, the Section of Biological Surveys, the Section of National Park Wildlife, and the Section of Wildlife Disease Investigations. Under the Section of Fur

of Birds, the Section of Biological Surveys, the Section of National Park Wildlife, and the Section of Wildlife Disease Investigations. Under the Section of Fur Resources, field stations include the U. S. Rabbit Experiment Station at Fontana, California, the Fur Animal Field Station at Cambridge, Maryland, and the Fur Animal Experiment Station at Saratoga Springs, N. Y. Highly scientific studies in connection with this general subject are conducted at the Beltsville Research Center at Beltsville, Maryland. The Section of Food Habits maintains a wildlife research laboratory at Denver, Colorado, and another at the Patuxent Research Refuge. The Section of Wildlife Disease Investigations maintains laboratories in Los Angeles, California, Brigham, Utah, Pullman, Washington, and at the Patuxent Refuge. Units of this Division directly responsible to the Chief thereof, rather than to the Sections, include the cooperative wildlife research units located at 10 points in the field, forest wildlife research studies conducted in cooperation with the U. S. Forest Service and other agencies, and the over-all management of the Patuxent Research Refuge.

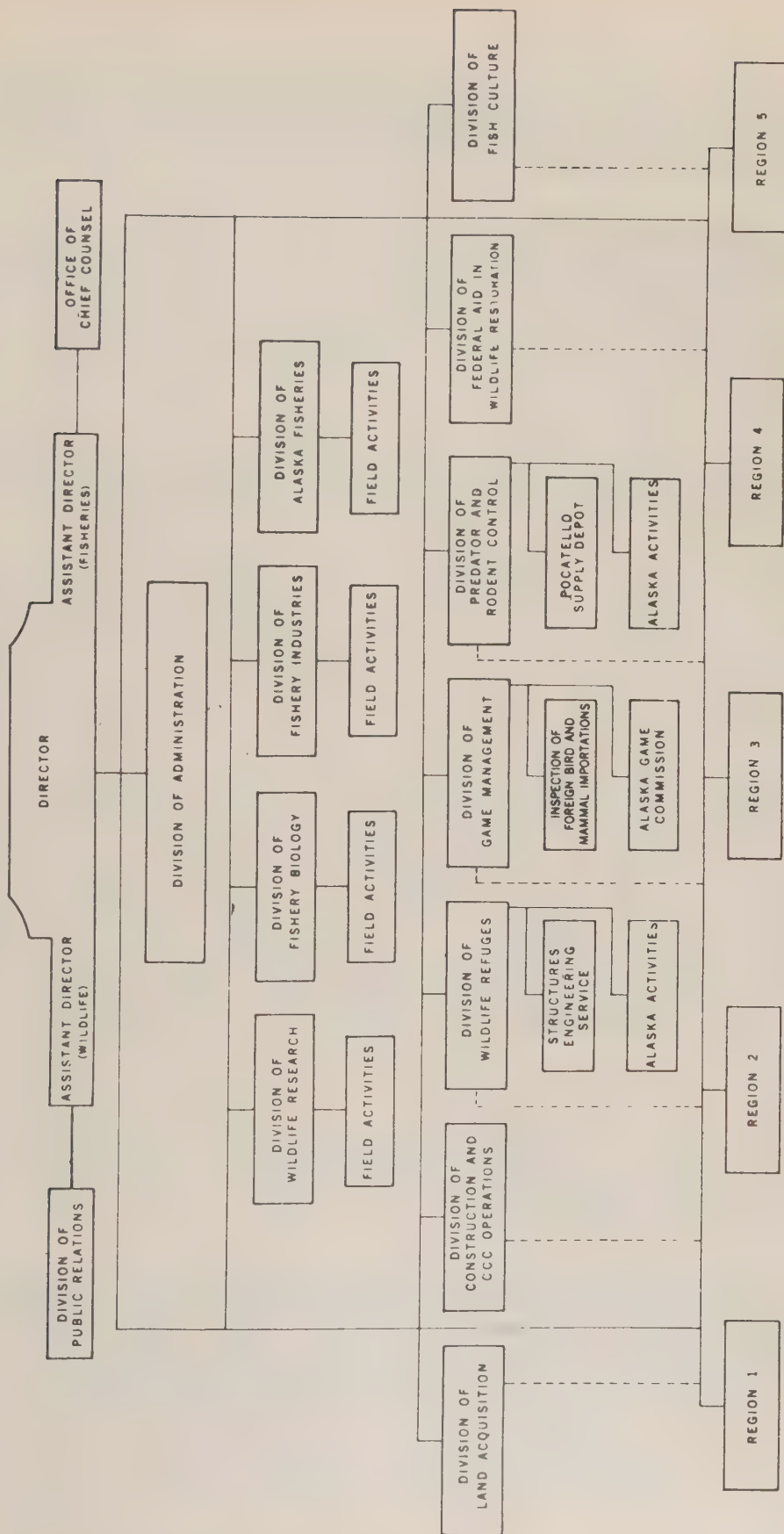
The Division of Fishery Biology plans and directs investigations and research in connection with food fishes and other aquatic life. This Division does not maintain a Sectional organization in Washington where it operates with a small number of employees. It carries on extensive investigations, however, at various points in the field. These include the Great Lakes fishery investigations, with headquarters at Ann Arbor, Michigan; aquicultural investigations with headquarters at Leetown, West Virginia; interior waters investigations at Columbia, Missouri; oyster investigations at Woods Hole, Massachusetts; hydraulics investigations, whaling investigations, and North Pacific fishery investigations at Seattle, Washington; South Pacific Fishery Investigations at Stanford University; shrimp investigations at New Orleans, Louisiana; North Atlantic fishery investigations at Cambridge, Massachusetts, and Middle and South Atlantic investigations with headquarters at College Park, Maryland. The officials in charge of each of these various stations are responsible to the Chief of the Division in Washington.

The Division of Fishery Industries collects and disseminates statistics for the improvement of fishery industries and conducts investigations in fishery technology. There are three sections in Washington--the Technological, the Statistical, and the Economics and Cooperative Marketing. The Statistical Section is organized into two units known as the Market News Unit and the General Survey Unit. Both of these units have field stations which report to them and, through the Statistical Section, to the Chief of the Division. Field stations of the Market News Unit collect, publish, and distribute daily information on the market supply and demand, commercial movement, location, disposition, and market prices of fishery products. Stations are located in New York, Boston, Seattle, Chicago, Jacksonville, and New Orleans. The Technological Section conducts activities at field stations located in College Park, Maryland, and Seattle, Washington.

The Division of Alaska Fisheries is responsible for all regulatory and other work necessary for the betterment of fisheries in Alaska, and for the fur-seal activities on the Pribilof Islands. This Division has a very small force in Washington and its field activities are handled largely from Seattle, Washington, and Juneau, Alaska. It is responsible for the regulation of salmon and other important commercial fisheries of Alaska. It also administers the fur-seal and fox herds on the Pribilof Islands and is charged with the maintenance and education of the native inhabitants of these islands who are virtually wards of the Government. The Division operates a fleet of some 15 Service-owned vessels, mostly seagoing, 6 speed boats, and chartered boats and airplanes in connection with enforcement and

ORGANIZATION CHART

UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE



patrol work. Close cooperation is maintained with the Alaska Game Commission, particularly in patrol and enforcement activities. Due to the location of the Division's field work it is necessary for the Assistant Chief to spend a large portion of his time in Alaska or Seattle.

The Division of Land Acquisition conducts appraisals, negotiations, surveys, examinations, and other work incident to the acquisition of lands selected for wildlife refuges and fishery stations. This Division contains two Sections--one responsible for appraisals and negotiations in connection with the acquisition of land, and the other responsible for engineering work, including surveys, and for the preparation of maps showing characteristics of lands acquired. The field work of this Division is supervised by the Regional Directors from the five regional offices.

The Division of Construction and CCC Operations is responsible for the management of 36 CCC camps located in 25 States. It also cooperates in planning all construction work carried on by the Service. This division has two Sections--one on Work Project Records and Fiscal Control, and one on Equipment, Safety, and Education--in addition to a Camp Service Unit located in Washington. Divisional responsibility extends to the actual conduct of the CCC work program including selection of administrative, supervisory, and facilitating personnel, and the apportionment and obligation of CCC funds. All plans for major construction at wildlife refuges, fish culture stations, and laboratory sites are reviewed by the Division before work is begun. The field work of the Division is supervised by the Regional Directors in the case of CCC camps, and usually by architects or engineers of the Washington office when other construction is undertaken.

The Division of Wildlife Refuges plans and directs the national wildlife refuge program. The Division contains five sections including the Section of Operations, the Section of Land Management, the Section of Habitat Improvement, the Section of Structures, and the Section of ERA (Emergency Relief Appropriation activities). In addition, fourteen wildlife refuges for the protection of native birds, animals and other wildlife in Alaska have an organization work flow direct to the Chief of the Division. In the continental United States all activities in connection with the supervision of the refuge program in the field are handled through regional offices, with the exception of the field engineering service under the Section of Structures, which reports directly to the Washington office.

The Division of Game Management enforces Federal statutes for the protection of wild birds, mammals and black bass, and, through the Alaska Game Commission, the Alaska Game Law. The Division contains three sections, in addition to the unit for Alaska Game Law administration; namely the Section of Game Agents, the Section of Law Enforcement, and the Section of Importations and Permits. Field activities are handled through regional offices, and for Alaska through the Executive Officer of the Alaska Game Commission.

The Division of Predator and Rodent Control plans and directs all predatory animal and rodent control projects and cooperates in these activities with States, counties, and other agencies. The Division in Washington is small and is not divided into sections. All activities conducted by the Division in the field are under the supervision of the regional directors, with the exception of the Pocatello Supply Depot at Pocatello, Idaho, the manager of which reports direct to the Chief of Division in Washington.

The Division of Federal Aid in Wildlife Restoration plans and directs the program under which financial aid is given to States for wildlife restoration. Here we have the Section of Program Planning, the Section of Lands and Structures, and the Section of Apportionments and Statistics. All field work of the division is conducted through the offices of regional directors.

The Division of Fish Culture supervises the operation of the Service's fish culture stations engaged in the propagation and distribution of fish for stocking public waters. This division has one section--known as the Fish Distribution Section. It is responsible to the Chief of the Division for maintaining records of fish applications and the planting of fish, and for the maintenance and operation of specially designed fish-distribution cars. An additional responsibility of this division is the maintenance of the aquarium in the Department of Commerce Building where there are on public display approximately 2000 specimens of live fishes. Since the consolidation of the Bureau of Biological Survey and the Bureau of Fisheries supervisors of fish culture have been assigned to most of the regional directors' offices. The field work of the Division of Fish Culture, involving 120 hatcheries in 45 States, will be supervised by the regional directors.

The Division of Administration plans and supervises the business activities and related problems of the Service. The work of this Division vitally touches every activity in the Service, and I shall go into a little more detail in explaining its functions. It contains five sections and two offices under the direction of the Business Manager.

The Section of Personnel and Pay Rolls is responsible for the handling of personnel matters and pay roll supervision. Included in its functions is the preparation of all recommendations affecting the employees. The Section handles correspondence regarding leave, injury and safety information of a general character, and office quarters in Federal buildings. This Section also assembles and maintains efficiency records, secures civil-service registers, and arranges for the holding of civil-service examinations. It prepares or reviews final papers in connection with the allocation of all positions under the Classification Act. The Section is responsible for procedure in pay roll preparation throughout the field and for preparation and certification of all Service pay rolls submitted to disbursing officers in Washington. Such duties include the maintenance of detailed records of salary payments, retirement deductions, and deductions for quarters furnished to employees. Cooperation is maintained with the Employees' Compensation Commission and injuries received by employees in the course of their duties are reported to that Agency.

The Accounting Section maintains appropriation allotment and cost accounting records, audits all vouchers except pay rolls, and handles all receipts. It reviews or prepares various types of contracts, such as rental agreements, cooperative agreements, and requests for leases. This Section recommends and supervises the establishment of field office auditing and accounting systems. It issues or reviews all letters of authorization and letters of travel instructions. It prepares correspondence and memoranda outlining policies, procedures, and practices relating to the auditing and accounting work of the Service. The Section handles approximately 85,000 vouchers a year. A considerable number of the employees of this Section will be transferred to regional offices by July 1 under a plan now in operation for decentralization of accounting work. Complete over-all control will be retained in the Washington office.

The Section of Purchase and Property is the central purchasing office of the Service. It prepares, reviews, or redrafts specifications on which bids are so-

licited and performs other work incident to the procurement of supplies, equipment, and property for use in the field and in Washington. The Section also prepares instructions to field officers concerning procedures to be followed in the issuance and acceptance of invitations to bid, and regarding purchases from Procurement Division contracts. It maintains property records and is responsible for checking and approving or disapproving annual inventories submitted by field leaders.

The Section of Mail and Files receives the incoming mail and dispatches the outgoing mail for the service. Incoming and outgoing mail for the wildlife group alone last calendar year totaled approximately 460,000 pieces. The Section is also responsible for supervision of the messenger pool service.

The Service and Training Section is primarily responsible for the improvement of business efficiency in the Service and for standardizing business procedure at the field stations. This Section was started about a year ago to fill a real need in the field. We found that otherwise excellent employees were still in the struggling stage when it came to handling business details necessary in their work. We appreciated the situation. These field men were hired in most instances to perform an important technical job. Few of them had any experience in handling and accounting for funds, or even in less detailed office duties. Now members of this Section make periodic examinations of field stations. They sit down with the field officer and help him straighten out his business problems. They explain unfamiliar or misunderstood matters. They aid him in bringing delinquent items up to date. They show the field officer how to set up proper files, records, and accounts, and they plan and put into effect in cooperation with him minor new procedures. From time to time members of this Section are also assigned the duty of making necessary investigations of fiscal irregularities and misconduct of employees. All reports on motor vehicle accidents in the Service are referred to this Section for handling. The Section prepares the monthly Service Letter of the Division of Administration. It has also taken the leading role in preparing the business management training course you will be offered during the next two weeks.

The Office of Budget and Appropriation Control and the Office of the Naval Architect are also parts of the organization of the Division of Administration. The former handles matters relating to the preparation of estimates, following this work through from its inauguration by the project leader until the appropriations are actually made by Congress. This office also maintains general appropriation control allotments, and handles correspondence on special subjects relating to expenditures in States or other subdivisions.

The Naval Architect is responsible for the designing of plans and the preparation of specifications in connection with the construction or remodeling of boats. He determines the type and power of motors most suitable for new boats or for replacement. He instructs field personnel in the proper maintenance and operation of floating equipment. The Fish and Wildlife Service operates approximately 160 boats equipped with inboard motors, 215 outboard motors, and 37 barges, quarterboats, and similar equipment. This is in addition to hundreds of rowboats and canoes. The value of all of this equipment is in excess of one million dollars.

This completes the Washington organization with its ramifications into the field. We shall now discuss the regional organization.

THE FIELD ORGANIZATION

Regional administration of activities was carried on successfully under the Bureau of Biological Survey first by the Division of Predator and Rodent Control

and later by the Division of Game Management before it was applied generally to all regulatory functions. During this later period the Division of Game Management was responsible for Predator and Rodent Control work. It was not until July 15, 1937, that Dr. Ira N. Gabrielson, following many conferences with his Washington staff and with field leaders, inaugurated the system embodying the general principles under which we now work. Under Dr. Gabrielson's plan at that time the country was divided into 9 regions, exclusive of Alaska, and all major activities except scientific research and land acquisition were placed under the field supervision of Regional Directors. Plans and instructions were worked out with extreme care--the objective being to retain policy-making functions and general control in the Washington office, and to delegate execution of such policies and supervision of work programs to the Regional Directors. Precautionary measures were taken to insure full coordination between the Director's office, his staff, and his Regional Directors, and thus preclude an undesirable organization consisting of nine variously conducted and more or less independent regions. While endeavoring to delegate to the Regional Directors ample authority to conduct their work efficiently and economically, they were nevertheless obliged to keep in close touch with the Washington office as to progress on major projects.

At the outset there was assigned to each Regional Director an administrative assistant whose qualifications leaned heavily to business administration. Regional Inspectors, selected on the basis of their qualifications along lines of functional activities, were also assigned as the work load demanded and funds became available. These men were definitely responsible to the Regional Directors. For example, the Regional Inspector for refuges was responsible for the handling of matters pertaining to all refuges within a given region, and in this capacity he acted as the representative of the Regional Director. Clerical and other personnel necessary for a rounded-out organization were assigned consistent with available funds. Under the 9-regional plan the headquarters of the Directors were located at Portland, Oregon; Denver, Colorado; Albuquerque, New Mexico; Des Moines, Iowa; Omaha, Nebraska; New Orleans, Louisiana; Milwaukee, Wisconsin; Boston, Massachusetts, and Atlanta, Georgia. This field organization continued for approximately three years.

During that period an intensive study was made of the over-all situation including the handling of functional activities, work flow, and other factors involving regional direction of activities. As a result of such studies we reached the conclusion that the constantly increasing work could be handled more efficiently, and eventually more economically, through a reduction in the number of regions and by staffing each regional office more adequately. Under the 9-region system, for example, we did not feel we had sufficient justification to employ Assistant Regional Directors. This resulted in the Regional Director being away from his office a large part of the year giving general supervision to major problems at work sites. The Directors, through no fault of their own, were becoming superinspectors instead of Directors.

There was too much detail to be handled by the top man--and most of the time he couldn't be at headquarters to handle it. He could, and did, delegate some of the work to the Administrative Assistant, but that official had a man-size job of his own. The dreaded "bottleneck" was fast becoming evident. With a reduction in the number of regions we could justify the employment of Assistant Regional Directors. The field program of the Division of Land Acquisition, not susceptible to separation into 9 regions, very readily fitted into 5. Due to the locations of its field work the Division of Construction and CCC Operations could operate more efficiently from 5 regional offices than from nine.



S. & M. JUNE 1940

Regions and Headquarters

Consequently, effective July 1, 1940, at the time of the consolidation of the Bureaus of Biological Survey and Fisheries, the nine regions were reorganized into 5 regions, each headed by a Regional Director and an Assistant Regional Director. The personnel of all abolished regional headquarters were transferred to the 5 new headquarters. Now the field work of the Division of Fish Culture is being made an additional responsibility of the Regional Directors. Except in actual emergencies either the Regional Director or the Assistant Regional Director is required to be at headquarters at all times. Numerous factors, such as economical transportation to field projects and adequate housing, were considered in the selection of new headquarters and boundaries of new regions. The five regions finally established in lieu of the nine previously in operation are as follows:

- Region 1 -- All Pacific Coast States, and in addition Nevada, Idaho, and Montana, with headquarters at Portland, Oregon.
- Region 2 -- The States of Wyoming, Utah, Colorado, Arizona, New Mexico, Kansas, Oklahoma, and Texas, with headquarters at Albuquerque, New Mexico.
- Region 3 -- The States of North and South Dakota, Nebraska, Minnesota, Wisconsin, Michigan, Missouri, Illinois, and Indiana, with headquarters at Minneapolis, Minnesota.
- Region 4 -- The States of Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, North and South Carolina, Tennessee, and Kentucky, with headquarters at Atlanta, Georgia.
- Region 5 -- The New England States, and in addition, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, and Ohio, with headquarters at Boston, Massachusetts.

Using Region 1 as a typical regional organization, we find under the supervision of the Regional Director at his Portland, Oregon, headquarters, seven definite functional programs in addition to general administration of allied activities. For example, in this region there are 11 full-time enforcement officers and some 400 non-salaried U. S. Deputy Game Wardens who report through the Portland regional law enforcement officer to the Regional Director: the CCC Inspector is responsible to the Regional Director for the operation of eight CCC Camps within the boundaries of the region; the Wildlife Refuge Inspector is responsible to the Regional Director for approximately 60 wildlife refuges; the Supervisor of Fish Culture for approximately 30 fish cultural stations; the Federal Aid Inspector for all Federal Aid activities within the region; the Land Acquisition Inspector for acquisition and surveys of lands acquired, and the Predator and Rodent Control Inspector (to be appointed) for all activities relating to the control of predatory animals and injurious rodents.

In all of this the Regional Director is responsible for the general supervision and the direction of field activities. The services of approximately 250 full-time employees and several hundred part-time and cooperative employees are utilized in Region 1. Correspondence and reports are addressed by the project leaders located at the site of the work to the Regional Director. This correspondence in turn is assigned to the appropriate inspector for handling, subject to the approval of the Regional Director. In this way there is a direct line of communication from the employee responsible for the smallest or largest project to the Regional Director. The Director's office, being staffed with specialists in functional activities, is able to handle the problem from a more immediate viewpoint and with a great deal more dispatch than would be the case if such matters had to be referred direct to the Washington office.

The real aim of good organization is to function effectively and economically; to reduce to a minimum dangling loose-ends for which no unit is primarily responsible. Both the Washington and regional organizations, as structures, are functioning satisfactorily under present conditions. These conditions may change. When we sense a change approaching we must be on the alert to meet it through modified procedures, improved technique, or even structural change in organization. Only in this way can we hope to maintain our good record for constantly increasing service in the conservation and perpetuation of our fish and wildlife resources.

REPORT PLAN WITH STATE FOR HATCHING AND PLANTING PIKE

The Fish and Wildlife Service reports a new angle in cooperation with the Minnesota State Conservation Department in connection with fish-cultural activities.

A tentative agreement recently drawn up provides that the Conservation Department's Fish and Game Division would furnish the Duluth Station of the Service with walleyed-pike eggs to be hatched at the above mentioned station, the resulting fry to be delivered to the United States Forest Service for planting in lakes in the Superior National Forest.

In addition, at New London, the Service would make collection of the walleyed-pike eggs from nearby waters. These would be hatched at the New London Station and the resulting fry would be delivered to the State Department for planting.

In the northern-pike operations at the New London station, all the fry or fingerlings resulting from this field operation would be delivered to the State Department for planting, except that a sufficient number of fry or fingerlings would be returned to the parental waters under State supervision so that the original stock might be kept up and increased.



IS WILD TROUT FISHING DOOMED?

By Lithgow Osborne
New York Commissioner of Conservation

C
IN CONNECTION WITH COMPLAINTS which are voiced from time to time with reference to the fishing in this state, I was interested last spring in the list of prize-winning fish caught by members of the Plattsburg Rod and Gun Club. It is not a very large club--about 300, I believe. It is, of course, situated in fairly favorable fishing territory, but no more so than dozens of other clubs. Here are the prize-winning fish which were caught within the restricted circle of this one club: speckled trout, 2 lbs. 6 oz.; rainbow trout, 1 lb. 8 oz.; brown trout, 10 lbs. 14 oz.; brown trout, 7 lbs. 6 oz.; brown trout, 6 lbs.; bass, 4 lbs. 7 oz.; bass, 4 lbs.; bass, 3 lbs. 13 oz.; musky, 23 lbs. 12 oz.; musky, 18 lbs. 3 oz.; and great northern pike, 14 lbs. 12 oz.

I doubt whether there is a state in the union where members of a comparatively small club enjoy such fishing as that list of prize-winners clearly indicates. If the list were for the state as a whole, it would be impressive. And yet, it relates to just one small corner of the state--to one limited group of anglers.

Here in the Adirondacks you specialize more in trout. You still have here much fine natural trout fishing. So I want to discuss the future of that fishing. Frankly, I am seriously concerned about it. I said natural trout fishing. By that I don't mean fishing in streams which have never been stocked. There is today only one body of natural trout water which has never been stocked--where the old original post-glacial strain of Salvelinus fontinalis has never been mixed with hatchery-bred fish.

¹A paper presented before the New York Isaak Walton League at Wanakena, September 6, 1940, and published in Outdoor America, November 1940. Reprinted by permission of the Isaak Walton League.

Natural trout fishing of that sort is definitely out. But certainly there is a difference between fishing for brooks and browns and rainbows which were spawned or have grown to maturity in a stream and are in every essential wild fish, and fishing for trout grown to legal size in a hatchery and "stocked for the rod" and frequently caught a few hours after their release. Several states have been reduced to just that type of fishing. In the more populous parts of this state we have been reduced to approximately similar conditions. If we are not careful that is the kind of fishing to which all of us will come.

Personally I haven't much use for it. I don't believe you have either. It is no true substitute for the genuine article. Is it necessary in New York to abandon true trout fishing for a third rate substitute, The trend--the pressure--all seems to be working in that direction.

For instance, the sportsmen generally demand the stocking of larger and larger fish. When six inches was the legal size they wanted six-inchers. Now that seven inches is the legal size they want seven-inchers. And if they can get trout eight or nine or ten inches, so much the better, so they think. I would like to raise grave doubts whether it is, in fact, always better, or even whether it is desirable.

Of course if you could plant the same number of eight-inch trout as you can fingerlings, obviously you would have more to catch. What is almost invariably overlooked is the vastly increased cost of raising the larger fish, and hence the smaller number you can plant with the same outlay of cash.

If, in a given stream, you plant a certain number of fry or fingerlings and of that number more live to be seven-inchers than you can raise in a hatchery for the same amount of money, clearly you are ahead of the game.

Who knows how many out of a hundred fingerlings or a thousand fry will survive one year or two years? The answer is: no one. Much more research must be done before anyone can answer that definitely. Almost certainly it all depends upon the nature of the stream. If a stream has a substantial and steady flow of sufficiently cool water, a certain amount of natural cover, an adequate supply of food, and it is not too much overfished, there is every reason to believe that such a stream will grow fish better and more cheaply than a hatchery and hence that it is sound policy to stock with fry or fingerlings.

But do sportsmen's clubs in territories where just such streams abound clamor for a larger number of smaller fish? Not often. They are inclined to think they are being gypped if fingerlings are sent to them, to say nothing of fry. The size of the fish alone seems to impress; not the number plus the ability of their streams to furnish conditions which will permit these smaller fish to develop. This mania for legal-sized fish has reached a point where one New York City columnist recently refused to consider stocking with fingerlings as of any significance whatsoever.

There is another point to remember, namely, quality. Certainly there can be no dispute which is the finer fish, one grown to maturity in a stream and one which is dumped in when he is already eight inches long.

In addition to this tendency to think that legal-sized fish are the only answer to our trout problems there is another and far worse fallacy, namely, that trout fishing must and should inevitably depend on artificial stocking, and that natural propagation no longer counts. When fishing gets bad the cry is always for more stocking, more stocking, as though that were the best way, in fact the only way, to produce better fishing. Far from being the best way, it is, unless it is co-ordinated with other measures, the least desirable because its effects are largely temporary. In the long run stocking, of itself, is the most expensive and least satisfactory way of producing better fishing. Some artificial stocking will always be helpful, even necessary, and in certain parts of the state such

stocking must perhaps be depended on for most of the fishing. But not in this section nor in most other parts of the state.

Natural propagation of trout in New York still produces many times the amount of fishing that artificial propagation produces. That is another basic fact that nearly everyone seems to overlook. For some reason it is taken for granted that Nature has quit work. She hasn't. She is doing all that she is allowed to do. She is ready to do much more, if we'll only let her. Instead we are giving her less and less of a chance each year. Nature needs seed stock to work with. Through the overfishing of our streams which has followed upon increased leisure, cheap gasoline and cheap cars and good roads we have been eating into our seed stock year after year. The Department through stocking can make good some of the loss. It can not make good all of the loss, or nearly all of it, without far more funds at its disposal than are in sight. The answer in our opinion is: better fish management. And among other things better fish management calls for decreased fishing pressure. I might express it paradoxically this way. We ought to catch fewer fish in order that we may catch more fish.

If you think that this apparent paradox is a pipe dream, let me give you an example, straight out of the Department's own record book, of what fish management can do. It may seem like a long way from trout to shad, more particularly because shad run back to the ocean after they have spawned. However, research has shown that shad return to their native rivers year after year so that a Hudson River shad can be considered as belonging to the Hudson quite as much as a Beaverkill trout belongs to the Beaverkill.

The shad fishery in the Hudson declined for years until it was only a fraction of what it had been. The department tried to bring it back with artificial propagation--just as with trout--and used to strip shad and release millions of fry. But the shad fishery continued to decline. It was not until a few simple management regulations were put into effect that it began to improve. Briefly these regulations were as follows: nets were lifted from Friday until Monday; certain known spawning areas were buoyed off and no fishing whatsoever was allowed on them; the navigation authorities were induced to alter slightly the steamship channel so that the wash from steamers would interfere less with the spawn deposited; the netting of deleterious species was encouraged during the summer months; the streams tributary to the Hudson were closed to netting. Then in more recent years a certain amount of pollution has been eliminated by the construction of municipal sewage disposal plants.

The shad fishery has staged an almost unbelievable comeback. In 1916 the catch amounted to only 40,000 pounds. Under the management plan it increased steadily during the ensuing 20 years until in 1936 the catch amounted to 2½ million pounds, and has averaged about 3 million ever since. From 40,000 pounds a year to 3 million!

Let me point out one or two things about those shad regulations. For one thing they call primarily for less fishing in point of time, that is a closed season of 2½ days per week, from sundown Friday night to sunrise Monday, and the areas were limited wherein fishing was allowed. In other words, there was less fishing with the objective of more fish. And that objective has been achieved. As a result of this self-denial the Hudson River shad fishermen are now catching more fish, and bigger fish. But they didn't at first. When the regulations went into effect they caught fewer fish and the Department was soundly berated for taking the bread out of the mouths of babes and sucklings.

The point is this; in the old days the fishermen used to take approximately 90 percent of the shad in the river. But as time went on that 90 percent, figured in pounds, was less and less. Nowadays they take only about 60 percent of the shad

in the river. But today's 60 percent far exceeds the 90 percent of a few years back. Nature has been given a chance to do a job of propagation. When we were taking 90 percent of the run that wasn't so.

Of course there are many ways in which the trout problem differs from the shad problem. Yet the principle involved is the same; Nature should be given a chance to help, if we want to preserve natural trout fishing.

Our hatchery system has been developed to a high degree of efficiency but that is no reason for failing to take full advantage of the tremendous potential reproduction capacity of New York trout waters. We are not doing it today.

If we were to apply the same principles of management to our trout that we have to shad, one point is worthy of particular note. The 40 percent of the shad which escape each year are not lost to the fishermen. Most of them return the next year as bigger fish. In the same way trout of mature size left in streams at the end of a season are not thereby lost forever to the anglers. For the most part they are still present the following year, larger in size and having contributed to natural propagation in the meantime.

Early last winter in the face of the most adverse conditions for trout which we have had in a generation, I suggested a radical decrease in the length of the season, a decrease in the creel limit and a limitation on the hours of fishing.

What I was pleading for was a program which would give Nature a chance to make up for the sock she unquestionably gave an already over-fished trout population last summer and last fall and last winter. Nature can only be given a chance to do that, if sufficient seed stock is left for her to work with. Precisely how that is to be accomplished, I don't care. There are a number of ways. I suggested a plan which seemed to balance the sacrifices as fairly as they could be balanced. But I was (and am) perfectly willing to accept any other plan which would accomplish the same result. No one suggested any other plan--or rather 50 people suggested 50 plans--all different--and of course none was adopted. I have seen or heard nothing this spring to make me think that I exaggerated the critical nature of the situation.

And it is no answer to say, "Let the Department do more stocking." The trout fisherman has had a larger proportion of the departmental appropriations spent for his benefit than his numbers actually warrant; and in justice to the bass fisherman, the pheasant hunter, the lake trout fisherman and the other groups of sportsmen, I am absolutely opposed to any larger proportion of expenditures going for brook, brown and rainbow trout. Take the trout anglers' fair share of the unexpended balance in the Conservation Fund and put it into more trout and the difference it would make would be small and, above all, temporary.

Of course if we in this state, with its 20,000 miles of trout streams choose to accept the proposition that from now on our trout fishing is to be simply a business of stocking hand-fed trout for the rod, that's one thing. Then it's merely a question of how many dollars you feed into one end of the machine in order to get out so many trout at the other end. You can get just as good fishing--if you call that sort of fishing "good"--as you choose to pay for. But I am utterly unwilling to accept any such proposition. I know that we can save real trout fishing in this state--even though in a few areas we must accept the stock-for-the-rod substitute as unavoidable. But it is nothing short of criminal supinely to accept any such substitute for the state as a whole, and it is the whole state that I am talking about. If other states without our natural advantages have been compelled to accept it, that is their bad luck. There is no reason we should copy them.

Let me sum up in the form of an eight-point program the policy which I believe should be followed to improve our fishing and in particular to save natural trout fishing.

1. ADJUSTMENT of seasons and creel limits and hours for fishing so that an adequate stock will remain at the end of the season. I say again that I don't care how this is done. But it must, as things stand, be done by the Legislature. It won't be done by the Legislature unless the sportsmen agree on a program.

2. INCREASE slightly the amount of stocking in accordance with the trout angler's fair share of the unexpended balance of the Conservation Fund. This is provided for in next year's budget.

3. SUSPEND any further increase in the percentage of legal sized trout to be planted, more particularly in streams which are suitable for natural growth of fry and fingerlings.

4. INCREASE the Department's supervision over the stocking of trout so that planting of trout will be more effectively done. This is in part provided for in the 1940-1941 budget.

5. BROADEN and increase scientific research and experiment to determine better hatchery methods and better stocking practices; what species should be planted in what streams, in what sizes and what quantities; and above all, to determine what becomes of our hatchery trout after they are planted and why. For years we have been spending relatively large amounts to propagate trout with no adequate research as to how many of those planted survive. This is also in part provided for in the 1940-1941 budget.

6. CONTINUE the purchase of fishing rights on Class A trout waters of the state until a minimum of 1000-1200 miles of such waters is acquired. This program is more than half completed and provision for its continuance is also made in this year's budget.

7. CONTINUE the program of stream improvement on state-controlled waters. To date 46,314 man-days of CCC labor have been expended on this work and 8,963 structures have been built on fourteen streams. CCC labor will be available again this year. In addition a small appropriation from the Conservation Fund was made for such work last year and a larger one is in this year's budget.

8. INCREASE stream pollution control. The greatest step in this direction taken in a generation will come with the establishment this year of an anti-pollution unit consisting of a mobile field laboratory manned by two trained biologists.

Such a program as the above would constitute the application of management principles to our trout problem. Please note especially that those items which lie in the Department's hands are already in process, namely, increased stocking, increased supervision over planting, scientific research, purchase of fishing rights, stream improvement and greater pollution control.

But these are not enough. They will be abortive unless we also have the first item on the program as a basis for the others, namely, an adjustment of seasons and bag limits which will make it possible for Nature to get to work in the natural trout factories which we have in almost every county in the state. In this matter the Department is absolutely helpless without the cooperation of the sportsmen. We can suggest; we cannot compel. I say again that the precise terms of such an adjustment are of secondary importance. There are a number of possible alternatives to, or substitutes for, the restrictions I suggested. I am ready to accept any such alternative, if the sportsmen will agree on one, so long as it is effective.

I am convinced that by a combination of sensible stocking and wise management practices, real trout fishing is very generally still possible in New York. But wise management practices will include, first and foremost, cutting down fishing pressure so that a proper seed stock is left at the end of each season in those streams which are suitable for natural propagation, as most of them are. And there is only one way I know of to cut down fishing pressure and that is to catch fewer

fish--for one season, two seasons, three or four or more seasons, if need be, so that eventually you can catch more fish.

At the present moment we are heading straight for the complete triumph of the hand-fed, hatchery-reared trout. And many sportsmen are apparently intent on helping us along that road. We are heading for a situation in which all those streams which are naturally productive won't produce any trout worth mentioning because there won't be enough seed stock left in them to make natural production possible. We are apparently preparing to discard our very best ally--Nature. I appeal to you who have such a great interest in real trout fishing to help me not to let this happen.

BEARS AND MEN BIG WORRIES AROUND FISH-REARING PONDS

Bears and men cause Richard Pfannes more trouble than anything else at the Clare County Rearing Station $3\frac{1}{2}$ miles south of Harrison, Michigan. Pfannes, who is caretaker of trout-rearing ponds constructed in part by the CCC and now administered by Clare County in cooperation with the Fish and Wildlife Service, said that he recently caught one Sunday visitor on his stomach trying to catch the trout with his hands. A pair of bears, however, caused Pfannes his greatest alarm. The bears, it turned out, had escaped from their enclosure at a nearby roadside amusement stand, and took their first opportunity to indulge in fishing. Despite these occasional difficulties, Pfannes says that the station rears about 200,000 trout annually.

VENEZUELAN HOLD TROUT RODEO

Good-will gestures between the two Americas being in order, the state of Merida, in Venezuela, recently climbed high on the bandwagon. They threw a Primer Torneo--a prize tournament, that is--devoted to sportfishing (in this case for rainbow trout), inviting folks fond of fishing, from all over the countryside, to participate or at least to be there. So, a piscatorial rodeo--"una prueba de pesca de truchas," as they say in Spanish--was held, with all the familiar trimmings of silver cups and bronze statuettes for prizes, on April 10-11-12-13.

Here's how the United States came in. The trout fished for were "planted" in the Venezuelan streams involved; they are not native to South American waters. In the years 1935 and 1938, 150,000 rainbow trout eggs from the United States Department of the Interior's Fish and Wildlife Service hatchery at White Sulphur Springs, Virginia, were shipped south to be reared and released in these foreign waters. In the years since, they've grown up to become legal prey for the tournament fly-casters.

As a result of its export business in fish and eggs, the Service, through its hatcheries, has populated waters literally all over the world. The comparatively large assignments of rainbow trout eggs were due to the fact that the Service has been for many years the principal source of eggs from the fall-spawning strain of this species. These eggs are in great demand because their early-hatching factor results in much larger fish for distribution during the spring months.

From the handbills advertising Meridan's recent tourney, it is seen that objectives of the "experiment" were not entirely confined to the sporting phase. The sound-mind-in-the-sound-body angle, emphasizing high morale to be developed by bringing neighbors from the whole state together for the holiday, and the matter of bringing to their attention this supply of a new species of fish good to eat -- these points both came in for prime attention. It is interesting to note, also, that Governmental officials in charge of the rodeo, cognizant of human frailty, advise the good innkeepers of Merida against boosting their prices during these four days of tourist invasion, and warn the parents of noisy children to keep same far away from competing fishermen concentrating on the catch.

MARKING TROUT UNDER ANESTHESIA

By Richard F. Foster
School of Fisheries, University of Washington
Seattle, Washington

IN THE SUMMER OF 1940 at Yellowstone National Park several thousand young black-spotted trout (Salmo clarkii lewisi) were marked by clipping the adipose and one of the pelvic fins. This fin-clipping experiment was initiated in connection with population and migration studies.

Ordinarily fish 4 inches in length, or larger, are used for marking purposes, but owing to the short season and cold water conditions at Yellowstone Lake the only fish available were very small, ranging in size from 1 to 3½ inches. At first these seemed ill-suited for the purpose, as it was difficult to hold and clip the fins on the smaller, active fish. Holding a struggling fish by hand was a slow and annoying procedure, conducive to a high percentage of inefficient markings and to injury of the small fish.

It seemed desirable to develop some method which would make the fish lie quietly in the hand while they were being marked, thus insuring accuracy with some degree of speed. This result could be achieved at least in part by lifting the fish out of water in a small net or wire sieve lined with muslin and allowing them to struggle until most of their energy was expended. Although they could thus be marked without much difficulty, the process was rather slow and the fish required several minutes to recover from the nearly complete exhaustion.

Griffiths, Webb and Schnieder¹, using adult steelhead trout, found that ether anesthesia greatly facilitated spawn taking. The following somewhat similar procedure was developed at the Yellowstone Park Hatchery and was used successfully in marking the small fish. The writer was assisted by C. Paul Marshall in the development of the technique, and by Mr. Marshall and other employees of the hatchery in the work of marking the fishes.

A 5 percent solution of C.P. ether was made up in a 100 cc. graduate and about a third of this poured into a small open container. Six or eight of the small trout were then placed in the bowl containing the anesthetic and allowed to become completely relaxed. The larger fish were the first to respond and in 15 to 20 seconds were completely anesthetized, while the smaller fish required a little longer. The original 5 percent solution became progressively weaker with continued use and by evaporation of the ether. When concentrations of between 2½ and 3 percent were reached the smaller fish required from 45 to 60 seconds to become quiescent. The weakened anesthetic was then strengthened by the addition of more of the 5 percent stock solution from the graduate. One hundred cubic centimeters of the 5 percent ether solution was sufficient to mark from 100 to 150 fish, depending on their size and the speed of the worker.

When sufficiently under the influence of the ether, the fish relaxed completely, turned belly up, and appeared to stop their respiratory movements. In such a

¹Griffiths, Webb, and Schnieder.

1940. Ether Anesthesia of Trout. Trans. Am. Fish Soc. 70; 272 - 274.

condition they were easily picked up in the hand and gently maneuvered into any desired position. It was then a simple matter to make a clean and accurate cut by placing the clippers close to the body of the fish and cutting off the fins at the base of the fin rays. In this way, 5 or 6 anesthetized fish could be marked in the time that ordinarily would be spent maneuvering a single active fingerling into the desired position. The fish thus marked were placed in a pan of fresh water to revive, a process which usually required from 1 to 3 minutes, depending on the strength of the ether solution and the length of time the fish had been in the anesthetic. As soon as the fish began to swim actively about the pan they were released.

Figures recorded early in the program showed that all of the larger trout and about 96 percent of the smaller ones recovered from the anesthesia. After the markers had become accustomed to the system it is probable that even a higher percentage of the smaller fish recovered.

In order to have some conception of the subsequent mortality due to the marking, 2665 fish collected at Pelican Creek were transported to the hatchery. Of these, 1815 were marked and held for about 2 weeks in a trough; the remaining 850 were left unmarked and were held as a control. The percentage of mortality was as follows: large marked,² 1.5 percent of 882 fish; large unmarked, 0.7 percent of 310 fish; small marked, 6.4 percent of 933 fish; small unmarked, 7.0 percent of 540 fish.

The mortalities that occurred among the marked fish seemed to take place within 12 hours after their fins had been clipped. However, it is apparent that there was no significant difference between the mortalities of the marked and unmarked fish.

Pelican Creek, a stream flowing into Yellowstone Lake, supplied the young trout used for this experiment. A small-meshed minnow seine was used to capture the small fish in the pools and weed beds of the creek. Except for those fish transported to the hatchery, marking was carried out on the bank of the stream and the trout were returned to the area from which they were taken as soon as they recovered from the anesthesia.

Continued seining of a particular area resulted in the recapture of a number of marked fish; this number progressively increased and when it reached from 5 to 10 percent of the total net haul a new section of stream was selected. Marked fish recaptured several days later, or even the same day, appeared no less vigorous than individuals captured for the first time. As a matter of fact, previously marked fish were not recognized until they were picked up for marking a second time and it was discovered that their fins had been clipped.

This method is well adapted for the marking of wild fish in the field, as a simple, light-weight equipment can be carried about easily. It is also easier for the worker, as he is not continually trying to hold the fish motionless and frequently becoming exasperated when it escapes him. The time saved and the larger number of fish marked soon offset the cost of the ether.

The advantages of ether anesthesia in marking small trout may be summarized as follows: (1) the fish are less likely to be injured; (2) clipping can be done with greater accuracy; (3) the method is faster; and (4) it is not so tiring to the worker.

² Fish over 1-3/4 inches in length were considered "large" and were marked by clipping the left ventral fin. Fish under 1-3/4 inches in length were called "small" and were marked by clipping the right ventral fin.

EGG PRODUCTION OF WALLEYED PIKE AND SAUGER

NORRIS RESERVOIR FISH DIFFER FROM SAME SPECIES IN OTHER LOCALITIES

By Charles G. Smith
Tennessee Valley Authority
Norris, Tennessee

INVESTIGATIONS SHOW THAT THE AVERAGE NUMBER OF EGGS produced by the female walleye varies from 50,000 or 60,000 per fish for the walleyes taken from Oneida Lake (Adams and Hankinson¹) to about 90,000 per fish, or about 45,000 per pound of fish, for the walleyes of Lake Erie (Leach²). According to Adams and Hankinson, Bean states that the female walleye may contain from 200,000 to 300,000 eggs.

In order to obtain an estimate of the number of eggs produced by the female walleye in Norris Reservoir, the eggs from a 6½ pound specimen taken in December 1939 were counted. The count revealed the number of eggs to be about 87,000 (see table). As this number--about 13,400 eggs per pound of fish--differed considerably from the number estimated by Leach for the fish from Lake Erie, it was decided to make additional egg counts of the walleyes from Norris Reservoir. In November and December, 1940, eggs were taken for counting from 3 more walleyes. Lengths and weights were generally provided by the anglers and where only one was given the other was determined from our length-weight data. Figures for length and weight of the fish are therefore only approximately correct. A CCC enrollee assisted with the counting. The ovaries collected from the anglers were preserved in 10 percent formalin for at least a week. Both ovaries from each fish were weighed, after which a weighed portion of each was counted and the total number of eggs per fish was calculated on a percentage basis by weight, except in one instance where all the eggs were counted. The eggs, naturally firm, were hardened by the formalin and could be separated from the ovary without damage. They were also large enough to be counted without the aid of a microscope. Unlike bass eggs, the eggs of both walleye and sauger are of uniform size and therefore may be accurately counted without difficulty.

When the results of this count, shown in the tables below, are compared with those of previous investigators, the differences are evident. Although Adams and Hankinson give no indication as to the size of the walleyes taken from Oneida Lake for stripping, they estimate the average number of eggs per fish to be 50,000 or 60,000. Of the 4 walleyes concerned in this count, 3 which were taken from the reservoir proper weighed about 6 pounds each, while one taken from the Clinch River below the dam weighed 13 pounds. The average number of eggs per fish was about 106,000, which is approximately double the figure given by Adams and Hankinson.

¹Adams, Charles C. and Hankinson, T. L.

1928. The Ecology and Economics of Oneida Lake Fish. Roosevelt Wild Life Annals, Vol.1, No. 48, pp. 241-548.

²Leach, Glen C.

1927. Artificial propagation of Pike Perch, Yellow Perch, and Pikes. Appendix 1 to the Report of the U. S. Commissioner of Fisheries for 1927. Bur. of Fish. Document No. 1018, pp. 1-27.

However, no close comparison can be made because the size of the fish obviously primarily determines the number of eggs present.

Leach gives the number of eggs per fish as 90,000 or about 45,000 per pound of fish for the walleyes taken from Lake Erie. According to Leach's estimate of 45,000 eggs per pound of fish, a 6-pound walleye taken from Norris Reservoir should contain about 270,000 eggs and a 13-pound fish should contain about 585,000 eggs. However, actual count showed the number to be about 80,000 and 170,000, respectively, while the number of eggs per pound of fish was approximately 13,500 and did not differ greatly from the small fish, about 6 pounds, and the large specimen, about 13 pounds.

Adams and Hankinson give no indication regarding the size of the walleyes which they quote Bean as stating may contain from 200,000 to 300,000 eggs per fish, but the number of eggs from the largest specimen in our group fell about 30,000 short of Bean's lowest figure.

If the estimates of the investigators cited above are correct, it is evident that the number of eggs produced by the walleye varies considerably according to locality or rate of growth.

The difference noted here between the number of eggs produced by the walleye in Norris Reservoir and the other localities may be due possibly to the comparative difference in rate of growth. In an unpublished manuscript, Eschmeyer and Jones give the following information in regard to the rate of growth of the walleye in Norris Reservoir:

<u>Year taken</u>	<u>Age in years</u>	<u>Total length in inches</u>
1940	1	10.5
1938	2	16.3
1939	3	20.1
1939	4	22.6

Growth of the walleye in Norris Reservoir was obviously much more rapid than in Lake Erie. According to Adamstone³ the growth of the walleye of Lake Erie was:

<u>Age in years</u>	<u>Total length in inches</u>
1/2	2.9
2-1/6	6.6
3-1/6	8.6
4-1/6	10.4

This information suggests that rate of growth may be a factor in the number of eggs produced, for, according to the available data, fish from Lake Erie produce about 3 times the number of eggs produced by the very fast-growing walleyes from Norris Reservoir.

So far as could be determined no previous investigations are available to indicate the number of eggs produced by the sauger. The table below shows the result of the egg count made from 4 females of this species taken from Norris Reservoir. The sauger showed an average of 58,250 eggs per fish and 31,600 eggs per pound of fish. In the absence of any previous information upon the egg production of the sauger, it is not known how the above figures would compare with the number

³Adamstone, F. B.

1922. Rates of growth of the blue and yellow pike perch in Lake Erie. Pub. Ontario Fish. Res. Lab., 20: 77-86.

of eggs produced by this species in other localities. The sauger is apparently the more prolific of the two, having about twice as many eggs as the walleye per pound of fish. Whether or not this is a factor in survival and abundance in waters where the two species compete is, of course, not known.

Table 1. Number of Eggs Produced by Several Walleye and Sauger from Norris Reservoir, Tennessee

Species	Length in inches	Weight in pounds	Month taken	Percentage of eggs counted	Number of eggs counted	Calculated total no. of eggs	Eggs per pound of fish
Walleye	26-1/2	6-1/2	Dec. 1939	9.6	8,345	87,000	13,384
"	25-3/4	6	Nov. 1940	26.6	20,630	77,500	12,916
"	25	5-7/8	Dec. 1940	24.5	21,435	87,400	14,876
"	33	13	Dec. 1940	100.0	171,300	171,300	13,176
Sauger	15-1/4	1-1/8	Nov. 1940	42.2	15,205	36,000	32,000
"	16-3/4	1-3/4	Nov. 1940	25.4	10,406	41,000	23,428
"	18	2-1/4	Dec. 1940	22.7	18,919	83,000	36,888
"	19	2-1/4	Dec. 1940	30.4	21,380	73,000	32,444

It is realized that the information secured from this count is limited and not adequate to show any definite indications as to what influence factors such as rate of growth may have on the number of eggs produced. It is presented primarily because it does indicate quite a different result than was obtained by other investigators for walleyes from Northern waters and presents a question as to why this difference exists.

FISHING FACTS IN VIRGINIA

The trout fishing season on St. Mary River, Virginia, was closed June 30 and the data were picked up on July 7. Forty-two fishermen spent 2,296 hours catching 840 trout. Of the 646 marked rainbow two-year-olds planted December 3, 1940, 333 or 51.5 percent were captured. Of the 927 yearling brook trout planted at the same time, only 153 or 16.5 percent were caught.

Of particular interest is the fact that only 153 out of the 927 brook trout planted were captured. Since it is generally known that brook trout are more easily taken than rainbow, it is not understood why there were fewer brook than rainbow captured. The opposite result was expected. Perhaps a poaching problem not heretofore suspected exists on St. Mary River.

The average angling day consisted of 5.3 hours: the average catch per angler was 1.9 fish per fisherman day, or .36 fish per fisherman hour. Of the 432 anglers, 190 caught no fish.

Data are still being collected from North Creek where the season closes on July 31. However, during the period April 21 to June 30, 5,119 hours were spent by 1,134 fishermen in catching 3,964 trout. This total number of fish included both marked and unmarked trout. A total of 4,000 marked trout were planted in this stream.

NOTES AND NEWS

Are Under-sized Trout Killed by Hooking?

IN DISCUSSING THE PRACTICAL VALUE of size limits, anglers often express the view that large numbers of hooked, undersized trout die when returned to the water. Direct evidence concerning the losses due to hooking was presented by Fred A. Westerman, Chief of the Division of Fish and Fisheries, Michigan Department of Conservation, in MICHIGAN CONSERVATION, Vol. 2, No. 12, December 1932. This evidence was based on a series of experiments conducted at the Harrieta Hatchery in Michigan in 1931 and 1932. So far as the editors of the PROGRESSIVE FISH-CULTURIST are aware, no other experiments on this problem have been conducted, and permission to reprint part of the original article has been obtained from Mr. Westerman and the Michigan Department of Conservation. The following paragraphs are quoted from Mr. Westerman's article.

"I believe that the mortality rate in fish returned is much less than generally supposed, or at least it can be kept low if care is used in handling the small fish when removing them from the hook. Some interesting hooking experiments have been conducted at the Harrietta State Fish Hatchery to determine just what this loss may be with fish taken by the use of the artificial fly, the ordinary baited hook, and the barbless baited hook. The first experiment was made in 1930, and it was repeated in 1932. The results are summarized as follows:

	<u>1930</u>	<u>No. of fish used</u>	<u>Lcss</u>	<u>Percentage of loss</u>
Pond No. 1 - Caught with artificial fly, No. 12 barbed hook, September 17th.....	200	5	2-1/2	
Pond No. 2 - Caught with No. 5 Sproat barbed hook, natural bait, September 19-20.....	200	21	10-1/2	
Pond No. 3 - Caught with No. 6 Sproat barbless natural bait, September 19-20.....	200	19	9-1/2	
Pond No. 4 - Caught with seine, September 20.....	<u>200</u>	..	..	
Total loss and percentage based on 600 fish caught with hook and line.....		45	7-1/2	

	<u>1932</u>	<u>No. of fish used</u>	<u>Loss</u>	<u>Percentage of loss</u>
Pond No. 1 - Caught with artificial fly, No. 10 barbed hook, September 15th.....	200	6	3	
Pond No. 2 - Caught with barbed hook, natural bait, September 14th.....	200	14	7	
Pond No. 3 - Caught with barbless hook, natural bait, September 15th.....	200	7	3-1/2	
Pond No. 4 - Caught with barbless hook, natural bait, September 21st.....	100	2	1	
Total loss and percentage.....		29	4-1/7	

NOTE: - Fish used in 1930 averaged from 5 to 7 inches in length. Practically all losses occurred within 24 hours. Experiment was terminated on October 31, 1930. Fish caught with seine used as a control. Fish used in 1932 ran from 3-1/2 to 7 inches in length; experiment continued 30 days. As in the preceding experiment, the major part of the losses occurred during the first 24 hours after hooking.

"Combining the results of these 2 experiments, we find a total loss of only 5.7 percent of 1,500 individuals. By gear, the losses may be expressed comparatively as follows: 2-3/4 percent using an artificial fly; 5-3/5 percent using the barbless hook, and 8-3/4 percent using the barbed hook baited. As compared with the artificial fly, the loss doubles when using the barbless hook baited and more than trebles when using the barbed hook baited. In all fairness, may I state that it is not known how frequently a returned fish may be repeatedly hooked through the season, but even if caught 10 times his chances of survival are about even.

"I am strongly opposed to limiting the kind of tackle to be used by statute, but I take real pleasure in presenting the results of these hooking experiments as an eloquent plea for an extension of the use of the artificial fly and barbless hook as the most sportsmanlike and humane manner of taking trout, one which should have a real appeal to the practical Yankee as an economic proposition in abating waste.

"In conclusion, it seems obvious that so far as maintenance of trout fishing is concerned, the size limit should be maintained as a practical conservation measure."

A School for Fish-culturists

THE APPRENTICE SYSTEM in fish culture is being partly discarded in favor of vocational education. Although the Federal Government has been operating fish hatcheries for almost 70 years, the skill of the trade has hitherto been acquired through actual experience. Because of the limited opportunities for practical education of persons adopting fish culture as a career, the Service has recognized that additional knowledge of biological principles and special technical methods will enable the fish-culturist to make each dollar spent for fish culture yield more satisfactory returns in the form of healthy fish and well stocked lakes and streams.

As part of a general program of in-service training for field employees of the Fish and Wildlife Service, a fish culturists' school has been established at the Service's hatchery and aquicultural laboratory at Leetown, West Virginia. A small dormitory was constructed during 1940 with P.W.A. and W.P.A. assistance in order to provide living accommodations for students.

According to the original plan developed nearly two years ago, a limited number of fish-culturists will be detailed to attend the school at Leetown for a period of one to six months to receive classroom and laboratory instruction in the sciences as well as practical training in improved fish-cultural methods. Two sessions are to be held each year, one during the winter when work with cold-water fishes such as trout will be emphasized, and a summer term when emphasis will be placed on warm-water fishes including the black basses, sunfishes, crappies and bluegills.

The first session of the school extended from February 24 to March 26, and was concerned primarily with the culture of cold-water fishes. The curriculum consisted of instruction in general biology; an elementary review of the classification, distribution, natural history, ecology, and physiology of salmonid fishes; fish pathology and parasitology; and lectures on special topics. Practical training was given in spawn collecting, care of eggs and fry, artificial feeding, transportation of hatchery-reared fish, and improved methods of stocking.

The training school is a joint project of the Divisions of Fishery Biology and Fish Culture, and is under the direction of Dr. H. S. Davis. Dr. James S. Gutsell and Mr. Eugene W. Surber, members of Dr. Davis' staff, and Mr. Reuben O. Knuth, foreman of the Leetown hatchery, assisted Dr. Davis with the instruction and demonstrations. Special lecturers who visited the station were: Dr. Ira N. Gabrielson, Director, Mr. Charles E. Jackson, Assistant Director; Messrs. Glenn C. Leach, and M. C. James, Chief and Assistant Chief, respectively of the Division of Fish Culture; Mr. Elmer Higgins, Chief, and Dr. H. J. Deason, of the Division of Fishery Biology; and Mr. E. J. Douglass of the Division of Fish Culture.

Creel Data on Clackamas River

A NGLERS INTERESTED IN fishing the waters of the Clackamas River should study a recent laconic report of Aquatic Biologist Reed S. Nielson. Verbatim, the report goes as follows, and carries its own moral:

"During the first month's operation of the Clackamas River Study project, a total of 311 creels were checked at the checking station: 140 from the study area proper and 171 from other waters in the immediate locality. These anglers fished a total of 1,145.5 hours to catch 835 trout. The average fishing effort was 3 hours and 40 minutes and the average catch 2.7 fish. The average time required to catch a fish was 1 hour and 22 minutes. The total weight of fish checked was 150 pounds 5.75 ounces.

"An analysis of the data obtained shows that of the total number of fish caught (835), 738 or 88.4 percent were rainbow trout and that 589 or 79.7 percent of the rainbow were in the 6- to 8-inch size group. Other trout represented in the catch are: Cutthroat 4.3 percent, Eastern Brook 6.3 percent, and Dolly Varden 1.0 percent.

"In the study area proper, 140 anglers fished a total of 903 hours to catch 722 trout weighing 102 pounds 11 ounces. The average fishing effort was 6 hours 45 minutes and the average catch, 5 fish. The average time required to catch a fish in the study area was 1 hour and 15 minutes.

"An analysis of the data from the study area proper shows that rainbow trout furnished 94.5 percent of the catch and that 83.6 percent of these were in the 6-inch to 8-inch size class. Cutthroat furnished 4.4 percent of the catch and Dolly Varden 1.1 percent. No brook trout were caught in the waters of the study area.

"The results of the second month's operation of the Clackamas River study area show an increase in the number of anglers from 140 during May to 298 during June. The average catch per angler decreased from 5 to 4.1 or 20 percent but this was accompanied by a decline of 40 percent in the average fishing effort, indicating a 20 percent improvement in the fishing. Rainbow trout are still furnishing practically all of the fishing, comprising 96.5 percent of the catch during June. The data also showed a trend toward larger fish.

"Results of the third month's operation of the Clackamas River Study show a very marked increase in angling effort and catch. During the month, a total of 642

anglers were checked. These anglers fished a total of 2600 hours to catch 3206 trout or an average fishing effort of 4 hours 3 minutes to yield an average catch of 5 trout. The total weight of all trout checked was 434 pounds 7 ounces. During the entire three-month period, 1080 anglers have been checked. These anglers spent a total of 4707.5 hours in fishing to yield a catch of 5153 trout having a total weight of 699 pounds 15.5 ounces.

"Of the total number of trout caught during the month (3206) from the waters of the study area, 3060 or 95.5 percent were rainbow, 139 or 4.3 percent were cut-throat, and 6 or 0.2 percent were dolly varden. Only one eastern brook trout was caught during the month. Analysis of the above data shows that 74.8 percent of all trout checked were in the 6- to 8-inch size class, 21.3 percent were in the 8- to 10-inch class, 3.2 percent were in the 10- to 12-inch class, 0.4 percent were in the 12- to 14-inch class, and 0.3 percent were over 14 inches in length. These figures closely parallel the three-month averages for the same data.

Experimenters Favor Conditioning Trout Before Planting

THREE OR FOUR WEEKS' "conditioning" in water having a current velocity of a foot to a foot and a half per second might give hatchery trout a better start in their life of freedom, J. W. Leonard and E. L. Cooper, Michigan fishery research men, believe.

Such a toughening process would have benefited 100 hatchery fingerlings 3 to 6 inches long, planted with an equal number of tagged wild brook trout of the same size in the first of a series of comparative experiments at the Conservation Department's Hunt Creek fisheries experiment station in Montmorency County.

Where the wild trout dispersed quickly in the marked-off section of the creek, the trough- and pond-reared fish at first appeared rather helpless in the current. Within six weeks after planting, 6 to 52 hatchery trout in one section died, where no deaths occurred among an equal number of wild trout.

One week after liberation the hatchery trout were eating only one-seventh as much food as the wild fish, but they learned fast and within four weeks were feeding nearly as well as their wild kin, stomach examination showed. Even at four weeks, however, they were eating food found principally in quiet water, while the current-loving forms such as the caddis were found generally in the wild trout diet and rarely were taken from stomachs of hatchery fish. The hatchery trout made a slight gain in length and had a slight loss in weight, where the wild fish made small but consistent gains.

Experiments at the Hunt Creek station are designed to find ways of making trout planting more efficient.

COMMENTS FROM OUR READERS

Comment on Carl's Article

EDITOR, the PROGRESSIVE FISH-CULTURIST:

Dr. Carl's article, "Beware of the Broken Egg", in the January-February issue, was read with particular interest by the undersigned who assisted with the initial experiment at Cowichan Lake Hatchery while on loan to the Fisheries Research Board.

No doubt all experienced fish-culturists were aware that broken eggs were detrimental to fertilization, but probably many did not realize just how destructive broken eggs could be. A perusal of Dr. Carl's article should dispel any doubt on the subject. It is to be regretted that he was unable to conclude his investigation of the "mechanism by which egg yolk interferes with the development of unbroken eggs", and of means to combat this interference.

In fairness to the fish-culturist who is sometimes regarded as a "dumb" animal, it should be pointed out that in 1927 Superintendent R. H. Eaton of Babine Lake Hatchery experimented with the effect of broken eggs on fertilization. While his experiment was not as well controlled as Dr. Carl's, the result indicated a similar conclusion. This experiment was reported in the Annual Report on Fish Culture, Department of Fisheries, Canada, 1927. It was with a view to substantiating Mr. Eaton's conclusion and the writer's own observations, that he suggested a further experiment along the same lines to Dr. Carl in 1937.

F. A. Tingley,
District Supervisor of Fish Culture
Saint John, N. B.

What Kind of Fish are We Planting?

EDITOR, The PROGRESSIVE FISH-CULTURIST:

In a few past issues there have been a number of complaints on the possible ill effects of haphazard distribution such as "What becomes of fish after they are planted", Fred J. Richan, October 1936, "What becomes of fish after planting", Ralph W. Young, March and April, 1937, and further mention of the subject by others from time to time.

I believe that in many cases the hatchery man who criticizes distribution would do well to question himself somewhat along the following lines.

Have you taken every opportunity to educate the members of organizations taking part in planting operations?

Have you made every effort to see that such fish planting as carried on from your station has been handled in the most efficient manner possible under local conditions?

Do you know that the condition of the fish upon leaving the hatchery is a very important factor bearing on his life thereafter?

Do you know that it is logical to believe that a fish that has been consistently over-fed and fattened requires a much greater period of time to adjust himself to his surroundings in his new home?

Do you know that it is possible to "condition" a fish for long trips and severe change in surroundings in his new home by proper control of quantity and content of his diet before leaving the hatchery?

Do you know that fish properly conditioned will react and adjust himself more quickly to such a change?

Do you know that the improperly reared fingerling lies groggy and sluggish in his new home for hours and sometimes days before favorable reaction sets in? And that such fish fall easy prey to larger fish and predatory birds? And that if you make a large plant of such fish in one spot it is necessary for the large fish and predators to "come and get it", while if you spread them over a large area by smaller plants in many spots you may be acting as a waiter in a restaurant, setting the hash before each customer? That this makes either method unsatisfactory?

Do you know that no matter how efficient the planting may be it cannot produce results worthy of mention if the fish that leave the hatchery are unfit for anything but a coddled life? Would you raise a son in the lap of luxury, rich foods and no exercise, and expect him to win track meets against tough competition? Would you expect a fat and lazy horse to ride in an overcrowded van without ventilation all night and win highly competitive races the next day?

Do you know that the hatchery man must depend on himself to learn how to handle many of these problems for himself because conditions are different at almost every hatchery and he can only be supplied with basic principles from outside sources? Do you know that to properly rear the fish for proper planting it is necessary to observe the progress of the fish and to understand what you observe as much as possible? Do you know that a fish that does not change color shade soon after planting to match his new surroundings has not been properly prepared for it or has not been properly transported and that observation of such reaction will help indicate proper procedure before planting? And that the fish that does not soon avail himself of natural cover or logs in the spot where planted is an indication of the same thing!

I believe that in many cases a large percentage of these questions would be answered in the negative and that if every hatchery manager would consider it a part of his job to improve distribution in his district he would find that the solution of the scientific problems of distribution would keep pace with his improvement in hatchery and field practice.

This is not offered as a criticism of those whose timely queries bring distribution faults to our notice but as a constructive criticism of a possible trend of thought. If none were to question poor methods there would be no progress. There is much evidence of active interest in the problems of distribution but, as is the case with the current distribution-of-wealth problem of the past few years, you could not get far with lead dollars.

F. W. Hollingsworth, Foreman in Charge
Ennis, Montana Substation,
Fish and Wildlife Service.

Non-migratory and Autumn-spawning Rainbow Trout

EDITOR, The PROGRESSIVE FISH-CULTURIST:

The occurrence of non-migratory rainbow and autumn-spawning rainbow trout in the Eastern United States has been referred to from time to time in the press and in departmental reports. None of these references that I remember intimate that the non-migratory and the autumn-spawning characteristics occur in the same group of fish.

With few exceptions, extremely little or no permanent results have followed the distributions of rainbow trout that have been made by this Department in the Maritime Provinces. In only one instance is there any indication of a non-migratory strain of rainbow trout having been established. In that case the creek and pond, in which some rainbow have remained, drain into a tidal stream. In all other instances where rainbow fishing is available, the fish are prevented from going to sea by natural or artificial obstructions.

A summary of the situation in the Eastern United States in regard to the development of non-migratory (migrating to sea and not returning to the rivers in which they were planted) rainbow trout and of autumn-spawning rainbow trout would be greatly appreciated.

J. A. Rodd
Director of Fish Culture
Ottawa, Canada

(REPLY)

Dear Mr. Rodd:

Your letter of January 27, which has been referred to me for reply, has reference to a problem on which there is still much difference of opinion. As you intimate, there is no evidence that the autumn-spawning and non-migratory characteristics necessarily occur in the same group of fish, and consequently it will be advisable to consider each characteristic independently of the other.

The autumn-spawning characteristic of the rainbow is apparently found only in hatchery fish and has been developed by rigorous selection. As you probably know, it was the opinion of the late Dr. G. C. Embury that all fall-spawning strains of rainbows reverted to spring spawners in natural waters, and most fish-culturists have held the same opinion. It is a very difficult matter to settle definitely, since most waters in the East that have been stocked with fall-spawning fish have also been stocked at some time with spring-spawning rainbows. Furthermore, the early-spawning rainbows which have been planted in eastern waters by the former Bureau of Fisheries were not all fall-spawners by any means. Many of them were from eggs taken during December and January. As a matter of fact, rainbow trout hatched from eggs taken from October to May have been planted in eastern waters during recent years which, of course, greatly complicates the situation.

Recent studies on the Davidson River, a mountain stream in the Pisgah National Forest, North Carolina, have shown that in this stream rainbow trout usually began to spawn in January, with the height of the spawning season in February. However, in 1940, the trout spawned about a month later, the delay evidently being due to an exceptionally severe winter, accompanied by large quantities of anchor ice in the stream.

The clearest evidence that rainbows may retain their early-spawning characteristics in natural waters is afforded by some recent observations by R. F. Lord on a lake in Vermont. Until very recently two strains of rainbow trout were maintained at the Pittsford hatchery, one spawning in December and January, the other in April. For several years Chittenden Reservoir, an artificial lake near the hatchery, was stocked with April-spawning strain and rainbows were observed spawning in small tributaries of the lake in early spring. Later the lake was stocked with winter-spawning rainbows, and it is claimed that since this policy has been followed the number of spring spawners has decreased greatly. However, there was some evidence that fish were spawning during the winter. If that was the case, they must spawn in the lake since the small tributaries are so blocked with ice at this time that no fish could enter them.

To determine if rainbows were spawning in the lake during the winter, Mr. Lord collected trout from the lake at frequent intervals during the fall and early winter. Two females were taken in December which apparently would have spawned within 15 days. Several ripe males were taken in the lake at the same time. The most conclusive evidence of winter-spawning was provided by an immature female which was captured on January 10. The stomach of this fish contained approximately 100 rainbow eggs in an early stage of development. All hatchery fish planted in the lake are marked, and it is noteworthy that all the fish that were nearly mature when captured were unmarked, which indicates that the fish may retain their winter-spawning character for at least one generation under natural conditions.

Turning now to the possibility of establishing a resident population of rainbow trout in eastern streams, we find abundant evidence that this has been accomplished in a number of instances. The presence of resident rainbows in the Davidson River has already been mentioned, and it is well known that other mountain streams in western North Carolina have supported a resident rainbow population for years. The large rivers to which these streams are tributary are too warm for trout in the summer, but during the winter months there is ample opportunity for them to migrate downstream if they so desire.

Rainbow trout are also reproducing naturally in the St. Mary River in the George Washington National Forest. This stream is too small to be considered well adapted to rainbow trout, but nevertheless the species has become established and, as shown by Surber (PROGRESSIVE FISH-CULTURIST No. 49, p. 12), the majority of the rainbows taken by anglers are wild fish.

Rainbow trout are known to be established in several streams in Vermont, the best known of these being Furnace Brook near Rutland. Catch records have been kept on this stream since 1935, and rainbow trout have made up 30 to 60 per cent of the catch, although no trout of this species have been planted in the stream in the past 15 years. Although Furnace Brook is a comparatively small stream, ripe rainbows are taken in the spring, and it is evident that they are reproducing successfully. At the lower end of the experimental section on Furnace Brook there is an impassable falls and dam so there is no possibility that the rainbow population is augmented by trout ascending from the lower reaches of the stream which also have a large rainbow population. Under the circumstances, there can be no question, therefore, that here we have a resident population of rainbows which is successfully maintaining itself under intensive fishing without assistance from artificial stocking. Furthermore, since Furnace Brook has been used as a test section the rainbows have extended their range several miles up the stream into the small headwaters, although brook trout are still in the majority in this section.

There are many other streams in the East and the North-Central states in which rainbow trout have become established. In some cases these streams flow into lakes from which trout migrate into the tributary streams to spawn. In many instances,

however, there are no lakes into which the fish can migrate, and it is evident that they are resident in the streams throughout the year, even though there are no obstacles to a downstream migration.

It appears that the two most important factors that determine whether rainbow trout will become established in a stream are (1) the character of the stream and (2) the strain of trout with which the stream is stocked. I am convinced that in many instances the failure of rainbow trout to remain long in the stream after stocking is due to the fact that conditions in the stream are unsuitable for this species. For example, the stream may be too cold or deficient in food or cover. Undoubtedly rainbows show a greater tendency to move downstream than do brook trout and this trait may determine their movements if stream conditions are unfavorable.

It also appears that rainbow trout prefer neutral or alkaline waters, and it is probable that this may explain the failure of this species to become established in many instances. In waters that are appreciably acid, brook trout will probably do much better than rainbow. On the other hand there is evidence that different strains of rainbow trout differ greatly in their tendency to migrate downstream. At one extreme we have the steelhead which is dominated by the instinct to migrate to the sea or a large lake, and at the other extreme we have the strain which has become established in Furnace Brook and matures and breeds in this stream even though there are no obstacles to prevent its migrating to Lake Champlain if it so desires. As you know, the various strains of rainbow trout have become so mixed at the hatcheries in many cases it is impossible to say whether they are predominantly migratory or non-migratory. To stock small streams with a strongly migratory strain of rainbow trout is, of course, inviting failure. In this connection, it is interesting to note that Thaddeus Surber (Transactions American Fisheries Society, Vol. 31, p. 241) states that for many years he found it impossible to obtain results with rainbow trout because they could not be induced to remain in the smaller streams but found their way downstream until they reached either the Mississippi or Lake Superior. Later, however, he obtained a stock of rainbow trout from Missouri which stayed in the smaller streams and provided excellent fishing where previously there had been no trout fishing at all.

H. S. Davis,
Associate Editor

Peeling Paint is Cause of Fingerling Loss

EDITOR, **The PROGRESSIVE FISH-CULTURIST:**

Recently some No. 3 fingerling which had been lost were examined and were found to contain particles of aluminum paint from the painted surface on the interior of the rearing tanks.

This paint had been applied over a white enamel paint which evidently was of a character that would not permit a proper bond between the two paints. Probably the loss of fish caused by this factor is very small; however these small losses all add up to the total loss. In view of this observation it should be borne in mind that if possible the same kind of paint should be used for succeeding applications so as to provide a good bond and prevent profuse peeling. A clean paint surface is also necessary to obtain good bond.

Hanford Thayer
Superintendent of Construction, Region 1
Fish and Wildlife Service

ABSTRACTS

SIXTH NORTH AMERICAN WILDLIFE CONFERENCE

PAPERS PRESENTED AT THE technical sessions of the Sixth North American Wildlife Conference held in Memphis, Tennessee, February 17, 18, and 19 were made available to the editors of the PROGRESSIVE FISH-CULTURIST through the courtesy of Mr. J. Paul Miller, Secretary of the American Wildlife Institute. Abstracts of selected papers of interest to fresh-water fishery biologists and fish culturists are presented below.

AN APPRAISAL OF STREAM IMPROVEMENT PROGRAMS OF THE NATIONAL FORESTS OF THE NORTHEASTERN STATES

By Theodore C. Fearnow
U. S. Forest Service

ANALYSIS OF THE results of stream-improvement programs in the Eastern Region of the Forest Service (Region 7) discloses many failures, due chiefly to faulty engineering rather than to misapplication of biological principles. Many of the original structures built in forests of Pennsylvania and Virginia in 1934 were destroyed by floods, but have now been replaced by devices built in conformity with engineering requirements for anchorage, etc.

Pools of the impounding type tend to act as sediment basins, whereas a low log projecting as little as 6 inches above the stream channel will usually dig a hole 4 feet deep or more in the stream bed and keep it open. Low lying, well braced, streamlined structures that offer minimum resistance to floods generally are more successful than structures depending on bulk and weight alone. Timbers permanently covered with water are less subject to decay than those partially exposed; therefore it is better to permit water to flow across the entire length of a dam than to cut a spillway in the crest of the top log. The simple, straight log dam has proved superior to V-shaped, K-shaped, and other elaborate types of log dams.

Double deflectors improved to include an additional member embedded in the stream channel have been used with good results to narrow the stream channel and accelerate the rate of flow.

Deep pools dug by directed flood action may provide safety areas for trout in time of protracted drought. Scattering such pools throughout long riffle sections brings about more uniform distribution of trout.

Intensive stream improvement programs should be safeguarded by long-range plans for watershed management. While proper stream improvement may aid in holding stocked fish in the stream, the value of stream improvement is generally overestimated by sportsmen. It should be regarded as a tool of management - not a panacea.

R.L.C.

DENSITY CURRENTS IN IMPOUNDED WATERS
THEIR SIGNIFICANCE FROM THE STANDPOINT OF FISHERIES MANAGEMENT

By A. H. Wiebe
Biological Readjustment Division
Tennessee Valley Authority

IN CONTRAST TO typical natural lakes, the waters of Norris Reservoir present 4, rather than 3, well-defined vertical zones with respect to dissolved oxygen during the period of thermal stratification. The additional zone consists of a stratum of stagnant water below the well-aerated surface stratum and usually within the thermocline. Available evidence indicates that this atypical distribution of dissolved oxygen is produced by sub-surface or density currents which in turn are the result of differences between the density of the reservoir water and that of the inflow from its tributaries. Differences in temperature, concentration of electrolytes, and silt content are the causes of these differences in density.

The shape of Norris Reservoir - deep, long, and narrow - favors the development of density currents. Similar distribution of dissolved oxygen has been demonstrated in two other reservoirs of comparable shape, Hiwassee Reservoir in North Carolina and Lake Herrington in Kentucky.

Game fish (bass, pike, and crappie) tend to orient themselves with respect to the stratum of stagnant water produced by density currents, remaining in the surface water during a wet summer when the entire reservoir below a depth of 30 feet becomes stagnant. However, since the stratum of stagnant water has a more attractive temperature than the warm surface layer, fish frequently invade the stagnant zone, lose their equilibrium, float for a time at the surface, and eventually die. Density currents may possibly affect the productivity of a reservoir by confining incoming plant nutrients to a stratum below the zone of photosynthesis.

R.L.C.

THE USE OF FERTILIZER FOR CONTROLLING THE POND WEED
NAJAS GUADALUPENSIS (SPRENG.) MORONG.

By E. V. Smith and H. S. Swingle
Alabama Agricultural Experiment Station

USUAL METHODS OF controlling objectionable aquatic and marsh vegetation by chemical or mechanical means are not applicable to the control of Najas. In the ponds of Alabama this week interferes with boating and fishing by its rank growth and tends to produce stunted populations of fish because it affords excellent cover for small fish and brings about over-crowding. The commonly observed fact that Najas does not grow in ponds that are muddy most of the year suggested a method of control by promoting a dense growth of algae. Experimental tests were made in 3 ponds badly infested with Najas. Applications of fertilizer were made in August

and September, 1938 and in April, May, June, July, and October, 1939. Each application consisted of 40 pounds of ammonium sulphate, 60 pounds of 16 percent superphosphate, 5 pounds of muriate of potash, and 15 pounds of dolomite per acre. A dense growth of filamentous algae followed the fall and early spring applications, killing most of the Najas by weighing it down and screening out the light. A heavy growth of phytoplankton served as a screen later in the season. By mid-July most of the Najas had died and decomposed. The following season Najas reappeared only in the largest of the 3 ponds, but fertilizing the pond induced a cycle of changes similar to those of 1939. Beneficial results were obtained also in two other ponds. The use of fertilizer is recommended as a method of weed control that also increases the growth rate of fish. Microcrustacea and insect larvae were very abundant about the masses of decaying Najas, and the increased food supply was reflected in the increase in the number and size of fish caught.

R.L.C.

TWO PROCESSES OPERATING FOR THE REDUCTION IN ABUNDANCE OR ELIMINATION OF FISH SPECIES FROM CERTAIN TYPES OF WATER AREAS

By Thomas H. Langlois
Franz Theodore Stone Laboratory

CHANGES IN THE abundance and species composition of the fish fauna of two types of lakes are considered. Increasing turbidity of a body of water like Lake Erie, caused by improper land-use practices of the past several decades, brings about other changes in the fish habitats which, in turn, are considered responsible for the reduction in abundance or elimination of certain fish species. The great reduction in the abundance of ciscoes and whitefish, which require clean, hard bottom for the successful incubation of their eggs, is attributed to the deposition of silt over the former spawning grounds. The decline in the abundance of yellow perch is associated with the destruction of vegetation by silt. Species that thrive in turbid water (saugers, sheepshead, catfish, and carp) have increased in abundance and in the commercial catch as the less hardy species have declined. Improvement of habitat by reduction of turbidity is recommended if choice species are to be restored. Soil conservation and construction of farm ponds and headwater reservoirs are considered of greater importance than the enforcement of legislative restrictions on fishing.

In small, isolated glacial lakes, changes leading toward the gradual extinction of the lakes themselves are associated with, and responsible for, the elimination of fish species, chiefly through the destruction of suitable breeding grounds.

Habitat changes are considered the principal and perhaps the only factors capable of effecting changes in fish associations, and additions to or withdrawals from the stock are held to be relatively unimportant. Restoration of declining fish species should consist of restoration of the essential habitat conditions.

R.L.C.

A PRELIMINARY REPORT ON THE CENSUS OF COMMERCIAL FISHING
IN TENNESSEE VALLEY AUTHORITY IMPOUNDMENTS

By Paul Bryant and Clarence M. Tarzwell
Biological Readjustment Division
Tennessee Valley Authority

A CENSUS OF COMMERCIAL FISHING was undertaken on the 3 lower T.V.A. reservoirs, Wheeler, Wilson, and Pickwick, in the spring of 1940. A total of 774 monthly records of the commercial fish catch was obtained, which listed a catch of 386,000 pounds of food and coarse fish. On the basis of these returns, it is estimated that over 900,000 pounds of fish were taken from these reservoirs in 1940. The average monthly catch was 500 pounds. Carp were predominant in the catch from Pickwick Reservoir and probably would have dominated the catch from other reservoirs if the fishermen had sought this species. Catfish were predominant in the catches from Wheeler and Wilson Reservoirs.

Approximately 43 percent of those engaged in commercial fishing derive their entire income from this occupation. It is estimated that 1,340 persons were supported wholly or in part by commercial fishing in the lower reservoirs during 1940. The average fisherman spends \$65.65 for equipment, and it is estimated that those who devote their full time to fishing have a net income of about \$600 per year. Each fisherman's family consumes 507 pounds of fish annually. The fishermen experienced difficulty in marketing carp. The majority of them were in favor of permitting netting in the reservoirs under license.

- Authors' Summary

A SECOND SEASON OF CREEL CENSUS IN THE LOWER T.V.A. RESERVOIRS:
GUNTERSVILLE, WHEELER, WILSON, AND PICKWICK

By Clarence M. Tarzwell
Biological Readjustment Division
Tennessee Valley Authority

THE CREEL CENSUS ON THE lower T.V.A. reservoirs in 1939 was expanded in 1940, when records were obtained on 47,030 fishing trips listing a catch of 158,590 fish, weighing 154,393 pounds, taken in 234,155 hours, or at the rate of 0.7 fish per hour.

Fishing is concentrated near centers of population and in tailwater areas. The catch was 0.5 fish per hour below Gunterville Dam, 0.9 below Wilson Dam, and 1.4 below Wheeler Dam; whereas it was 0.4 fish per hour in Gunterville Reservoir, 0.5 in Wheeler Reservoir, and 0.8 in Pickwick Reservoir.

In the area as a whole, 25 percent of the anglers failed to catch fish. The average time spent fishing was 5 hours, and the average catch was 3.4 fish weighing 3.3 pounds. The best fishing in the area was below Wheeler Dam, where only 5 percent failed to catch fish and the average catch was 8.2 fish weighing 7.4 pounds.

Fishing was heaviest during April, May, and June, but in general the catch per hour was largest during the fall months. The catch of game fish usually falls off

during July and August. Game and pan fishes comprised 50 to 98 percent of the catch of boat fishermen and 27 to 95 percent of the take of bank fishermen.

In the new T.V.A. reservoirs game fishes are more abundant in the catch than they are in most natural lakes, and the average catch and the catch per hour approaches those of northern lakes for which creel census data are available. Fish taken from the lower reservoirs during 1940 weighed, on the average, one pound.

Although fishing is poor during the first year of impoundment, there is evidence of a large and successful hatch of fish the first year. Game fish are caught in large numbers during the second season of impoundment, but tend to decrease during the third and fourth years while pan fish increase. Changes in the composition of the catch were rapid and pronounced. In some areas drum largely replaced the game and pan fish in the catch during the summer months. Below Guntersville Dam, white bass increased in the catch and sauger dropped off, while the reverse was true below Wilson Dam. A continuing fishery inventory is needed as a basis for regulations to maintain the fishery.

Observations on the catch of carp suggest that water fluctuation during the spawning season may be utilized in the control of this species. Netting for the control of carp appears desirable. A closed season on bass during the spawning season is also recommended.

That impoundments do not invariably become "biological deserts" even after 16 years is shown by Wilson Reservoir, which had the highest yield (32 pounds per acre) of the lower reservoirs during 1940.

- Author's summary

DATA ON SPAWNING RUNS OF LAMPREYS SOUGHT

Heavy spawning runs of sea lampreys in the Ocqueoc River, Presque Isle county, and their reappearance in the Clinton river, Macomb county, ahead of the usual schedule have brought an appeal by the conservation department for cooperation of sport fishermen in reporting the extent of the spawning this year.

A nuisance to commercial fishermen and to lake trout sport trollers, the sea lamprey has been extending its range in the upper Great Lakes each year since it first got into Lake Erie by way of the Welland Canal in 1921. Farthest north reached in 1940 was the Pine River near St. Ignace.

Sea lamprey scars on commercial fish decrease their market value, and when the lampreys are abundant they do extensive damage to fish populations. The eel-like creatures are parasites which feed on the blood of other fish to which they cling by means of a sharp-toothed, sucking mouth. They are distinguished from the comparatively harmless native lamprey by their greater size, divided dorsal fin and mottled coloration.

Some lampreys now running in the Ocqueoc River are said to be more than 30 inches long. They spawn on gravel bottoms in fairly strong current, below dams, holding to stones on the bottom with their sucker mouths and waving their tails near the surface. Since they die after spawning, they must be destroyed as they enter the streams if their numbers are to be reduced.

Runs have been observed for four years in the Ocqueoc and Clinton Rivers, and it is believed they spawn unobserved in other streams. Organized control of the pests--by netting, trapping or spearing as they enter the streams to spawn--may follow if runs are found extensive and experimental control measures prove practical.

REVIEWS

WILDLIFE CONSERVATION

By Ira N. Gabrielson

Published by the MacMillan Co., New York City, \$3.50

THIS BOOK BY THE DIRECTOR of the federal Fish and Wildlife Service should be in the library of every fish-culturist, not because it contains information on the culture of fish--it does not--but because it states in clear, concise language the basis of all conservation efforts. The progressive fish-culturist now realizes that if he is to do his job properly, he must know ~~something~~ about the conservation of all natural resources.

The opening paragraph is the key to the book. The first two sentences state the problem of the conservationist. "Air, sunshine, soil and water are the bases on which renewable, or organic, resources are built. Consequently, any practice that has an adverse effect on any of the four will be reflected in reduced production of the plants and animals on which man must depend for food and in the availability of habitable land." The cycle of life starting with bacteria and ending in fish and wildlife crops is clearly explained and the importance of each of these four bases of renewable resources is discussed. Then follow chapters on the conservation of the soil, water, forests and grasslands and the important animals of each. Next comes a chapter on "some basic facts in wildlife conservation." Ecology is defined and its significance in wildlife conservation is discussed. The effects of the introduction of exotic species are considered with examples mainly from wildlife.

The latter half of the book deals specifically with wildlife problems (mostly game) and is of less direct interest to the fisheries man. However, most fish culturists seem to be hunters and they will enjoy the chapter on resident game, migratory birds and fur animals. The chapters concerned with non-game birds and mammals and with rare and vanishing species will be of general interest, but the chapter on predator relationships, especially that part on fish-eating birds, is directly in the fish-culturist's field. Gabrielson defends predator control when "Human interests, primarily economic" are involved and when "the numerical ratio of game animals and game birds to their natural predators may be disturbed when human hunters in large numbers enter the field." The statement concerning fish-eating birds should be quoted since it presumably reflects the policy of the Fish and Wildlife Service. "At hatcheries and places where fishes are confined in small feeding and rearing ponds, losses by fish-eating birds may be very serious, and under such conditions control or protection may be fully justified." Except in the case of unusual, local concentrations of fish-eating birds no control on natural waters is thought to be warranted by the facts available.

As might be expected, Gabrielson's illustrations are largely drawn from the field of game conservation, but he states that "Fish management is not different basically from quail or deer management. The two fundamentals are: (1) to provide suitable environment and (2) to limit the harvest to the crop produced."

Incidentally, there has been much clamor for a textbook on conservation for the public schools. It is this reviewer's opinion that in Gabrielson's book we now have an excellent text on wildlife conservation suitable for high school or junior college use. The summary or discussion of practical applications at the end of each chapter adds greatly to the book's value either as a text for the student or as a reference for the field conservationist. Numerous excellent photographs and charts drawn largely from federal files or publications add greatly to the interest and usefulness of this book.

Albert S. Hazzard
Institute for Fisheries Research
Ann Arbor, Michigan

(Continued from inside front cover)

APPLICATIONS for this memo, which is distributed free on regular mailing lists should be addressed to the Director, Fish and Wildlife Service, Washington, D.C. Contributions for publication are welcome.

While a certain amount of editorial selection of material is exercised, the Fish and Wildlife Service does not necessarily endorse and is not responsible for the statement of facts nor for views and opinions published herein.

NOTICE REGARDING CHANGE OF ADDRESS

IT IS THE aim of the Service to maintain an up-to-date mailing list for the PROGRESSIVE FISH-CULTURIST and to record promptly requests for change of address. Owing to the method of filing address cards and maintaining the addressograph plates, it is important that anyone requesting a change of address notify this office of both the old and the new address.

